NASA-CR-178322

737 Graphite Composite Flight Spoiler Flight Service Evaluation

Randy L. Coggeshall

Ninth Report

January 1985
Through December 1986

(NASA-CR-178322) THE 737 GRAPHITE COMPOSITE FLIGHT SPOILER FLIGHT SERVICE EVALUATION Progress Report, 1 Jan. 1985 - 31 Dec. 1986 (Boeing Commercial Airplane Co.) 43 p
Avail: NTIS HC A03/MF A01 CSCL 11D G3/24

N87-29609

Unclas
0100069

Prepared Under Contract NAS 1-11668 by
Boeing Commercial Airplane Company

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23665

August 1987

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA CR-178322		

4. Title and Subtitle	5. Report Date
737 Graphite Composite Flight Spoiler Flight Service Evaluation	July 1987
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Randy L. Coggeshall	
9. Performing Organization Name and Address	10. Work Unit No.
Boeing Commercial Airplane Company P.O. Box 3707 Seattle, WA 98124	505-63-01-06
	11. Contract or Grant No.
	NAS1-11668
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Aeronautics and Space Administration Washington, DC 20546	Ninth Report Jan 1985—December 1986
	14. Sponsoring Agency Code

15. Supplementary Notes Use of commercial products or names of manufacturers in this report does not constitute official endorsement of such products or manufacturers, either expressed or implied, by the National Aeronautics and Space Administration.
Langley Technical Representative; H. Benson Dexter.

16. Abstract

The ninth flight service report was prepared in compliance with the requirements of Contract NAS1-11668. It covers the flight service experience of 111 graphite-epoxy spoilers on 737 transport aircraft and related ground-based environmental exposure of graphite epoxy material specimens for the period of January 1, 1985 through December 31, 1986. Spoilers have been installed on 28 aircraft representing seven major airlines operating throughout the world. An extended flight service evaluation program of 15 years is presently underway. As of December 31, 1986, a total of 3,339,608 spoiler flight-hours and 3,320,952 spoiler landings had been accumulated by this fleet.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Graphite-epoxy Composite spoiler Environmental exposure	Unclassified—Unlimited Subject Category 24

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	44	A03

FORM 0005 For sale by the National Technical Information Service, Springfield, Virginia 22151

FOREWORD

This is the ninth progress report on the service evaluation of graphite-epoxy flight spoilers for 737 aircraft. This effort has been conducted as a portion of NASA Contract NAS1-11668, "A Study of the Effects of Long-Term Ground and Flight Environment Exposure on the Behavior of Graphite-Epoxy Spoilers." The program is structured to gather and evaluate actual commercial service experience on a large number of graphite-epoxy spoilers and test specimens in a wide range of operating environments. One additional report will be prepared and submitted after the completion of the flight service period, which is programmed to provide 15 years of flight service.

Tabular flight service data is included in three appendices. Appendix A summarizes the spoiler program data. Appendices B and C are status reports of the flight service data generated under NASA contracts NAS1-14952, "Boeing/NASA 727 Graphite Composite Elevator," and NAS1-15025, "Boeing/NASA 737 Graphite Composite Stabilizer."

The program is administered by Langley Research Center, National Aeronautics and Space Administration. H. Benson Dexter, Materials Division, is the technical monitor and is responsible for test and evaluation of ground-based environmental exposure specimens for the program.

The program is being conducted at the Boeing Commercial Airplane Company under the direction of Jay M. Hopper, program manager. Randy L. Coggeshall, Advanced Structures Group, is the program technical leader.

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PROGRAM SUMMARY AND STATUS

The ninth flight service report is submitted in accordance with the requirements of Contract NAS1-11668 and covers the service evaluation portion of this NASA contract from January 1, 1985 through December 31, 1986. Segments of the data contained herein have appeared in previous documentation (refs. 1 through 10).

A primary objective of this program is to produce 114 graphite-epoxy 737 flight spoilers for testing and service evaluation deployment. One spoiler of each of the three different graphite-epoxy material systems used has been laboratory tested for stiffness and strength in partial fulfillment of FAA certification requirements. Four spoilers were initially installed on each of 27 aircraft representing five major airlines operating in different environmental circumstances. Since that time, some aircraft have been sold by the initial operator, and some spoilers have been redeployed within the fleet due to normal maintenance schedules. These installed spoilers (units) will be monitored under actual load and environmental conditions for 15 years. Selected units are removed periodically to evaluate any material property changes as a function of time. Six environmental exposure racks have been fabricated and positioned at major airport terminals of the participating airlines in various parts of the world and at NASA-Langley Research Center to gather ground-based environmental data to support the flight data gathered from the spoilers. Material coupons have been tested after 1, 3, 5, 7, and 10 years of outdoor ground-based exposure.

Significant events that have occurred during this period include:

- Continuation of nondestructive inspection (NDI) sampling program and static testing of spoilers from the flight service program
- Continuation of the skin laminate moisture absorption study

As of December 31, 1986, 2,339,608 spoiler flight-hours and 3,320,952 spoiler landings have been accumulated by the fleet. The high-time spoiler had accumulated 37,572 flight-hours on Frontier Airlines 737 N7386F. Seventy-three spoilers have accumulated more than 16,000 flight-hours since the beginning of the flight service program, and 21 spoilers have had uninterrupted service since their original installation.

Laboratory testing of spoilers, returned from 12 years of flight service, continues to demonstrate that the spoilers retain a high percentage of their unexposed strength. Several units were tested with service-induced damages. These damages included exfoliation corrosion in the spar and skin delaminations. Even with corrosion damage the units had residual strengths that fell above design limit load. Results of these tests will be used to establish defect limitations.

Maintenance damage and related repair activities have continued at a modest level. Seven spoilers were removed (unscheduled) during this reporting period. These spoilers will be retired from service unless repairs are conducted by the airline. Airlines continue to exhibit enthusiasm for and confidence in the program. Several of the airlines have reported significantly reduced maintenance with the graphite-epoxy units when compared with the production aluminum-skinned units.

As a result of a contract modification, repair activities by Boeing have been suspended, although several airlines will continue to perform repairs at their own maintenance bases. There will be no further inspection trips by Boeing personnel. Residual strength tests will be conducted after 15 years of service and a report will be issued to document the results.

PROGRAM SCOPE

The service evaluation program was established to place the 737 graphite-epoxy flight spoilers into a commercial service environment containing as many climatic variables as possible. The five actively participating airlines have 19 aircraft currently committed to the program.

Currently participating airlines are:

- Air New Zealand, Ltd.—three aircraft
- Deutsche Lufthansa Airlines—four aircraft
- Piedmont Airlines—eight aircraft
- VASP Airlines—three aircraft
- Frontier Airlines (Continental)—one aircraft

The geographic scope of the service evaluation program continues as shown in Figure 1.

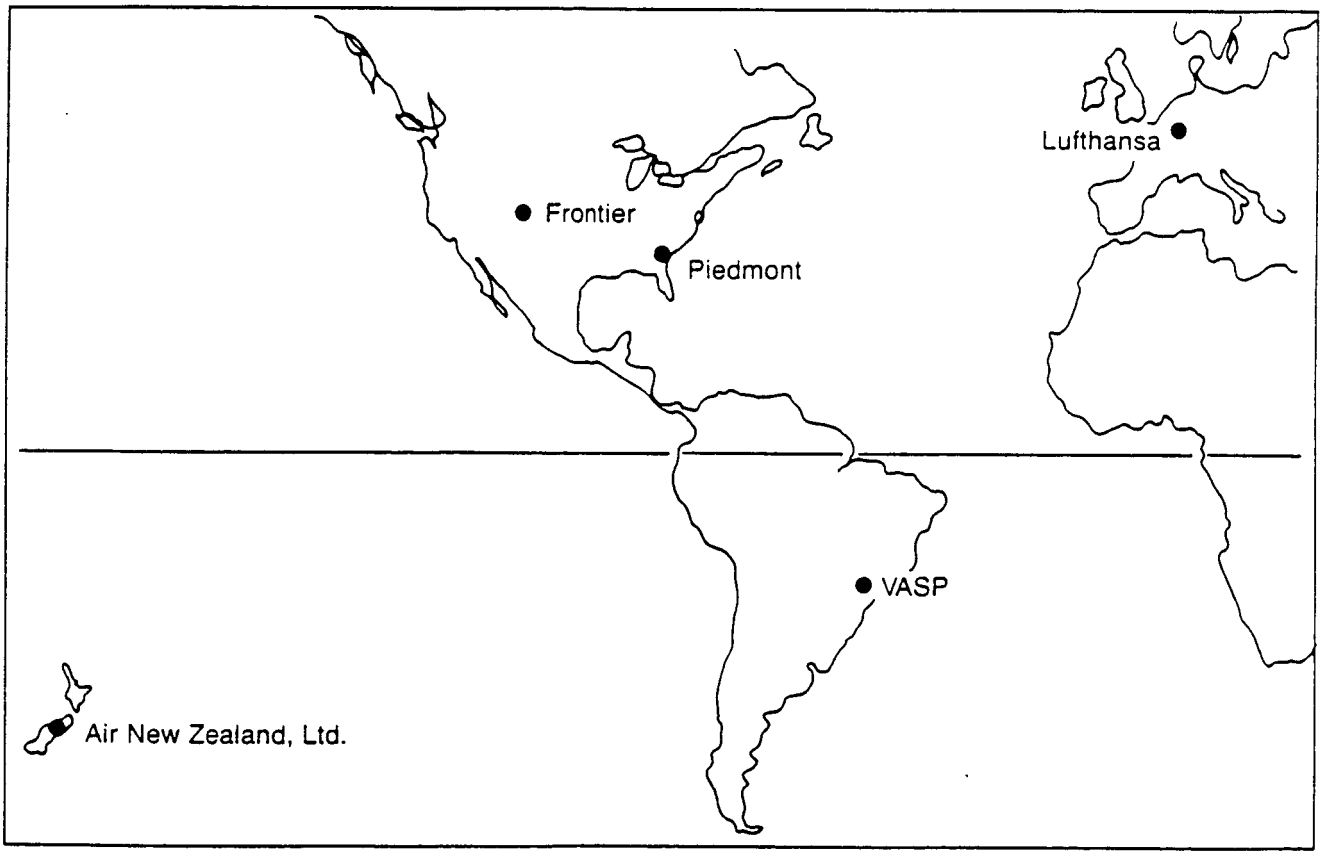

Figure 1. Geographic Deployment of Currently Participating Airlines

FLIGHT EXPERIENCE

The graphite-epoxy 737 flight spoiler flight service evaluation program, in operation since July 18, 1973, has achieved an exceptional level of commercial service exposure. The program has generated over 2 million flight-hours of service and over 3 million landings in over 12 years of operation and is adding flight experience at the rate of over 10,000 hours a month.

Total flight experience to December 31, 1986, is summarized in Table 1 by type of graphite-epoxy material. Table 2 summarizes the same data by airline. VASP and Frontier data include only flight experience since acquisition of their respective aircraft from PSA. A total of 73 spoilers have accumulated over 16,000 flight-hours each. Their distribution, by airline and by skin material system, is shown in Table 3.

A Fortran program called PSPOIL was established to periodically update the service history of the spoiler fleet. The computerized approach saves time and improves accuracy of the data. The program provides all of the data shown in the three tables plus installation and removal dates and the current status of spoilers (i.e., flying, out for repair, destroyed in test), Appendix A.

Spoiler material type	Net hours	Net landings
Union Carbide T300/2544	779,887	1,056,103
Narmco T300/5209	815,005	1,087,722
Hercules AS/3501	744,716	1,087,127
Total	2,339,608	3,230,952

Table 1. Flight Spoiler Service Experience by Type of Material (as of 12-31-86)

Airline	Number of aircraft in evaluation	Number of spoilers in evaluation	Total spoiler hours since installation	Total spoiler landings since installation
PSA	0	0	29,747	51,521
Aloha	0	0	174,791	444,994
New Zealand	3	11	305,207	417,074
Lufthansa	4	9	521,260	634,113
Piedmont	8	21	866,627	1,193,016
VASP	3	7	345,921	388,141
Frontier	1	1	96,055	102,093
Total	19	49	2,339,608	3,230,952

*Total placed in service is 111 spoilers, with 62 spoilers either inactive, retired, or tested

Table 2. Flight Spoiler Service Experience by Airline (as of 12-31-86)

Part number	Airline					Total
	VP	LH	PI	Frontier	NZ	
-1 (T300/2544)	5	4	12	0	2	23
-2 (T300/5209)	3	6	6	2	9	26
-3 (AS/3501)	3	8	9	0	4	24
Total	11	18	27	2	15	73

Table 3. Distribution of Spoilers With 16,000 or More Flight Hours

SCHEDULED SPOILER REMOVALS AND EVALUATION

During this reporting period, 3 twelfth-year spoilers were removed from the flight service program for evaluation and test. All removed spoilers were reinspected using through-transmission ultrasonic C-scan, and the results were compared to the records made at the time of original fabrication. The units were considered damage free following nondestructive inspection.

Following selection for test, the units were photographed. Figures 2 and 3 show the upper and lower surfaces, respectively, of spoiler S/N 0032 after 12 years of service. This unit was previously repaired over the center hinge fitting. The repair was sound and this unit was clear of damage.

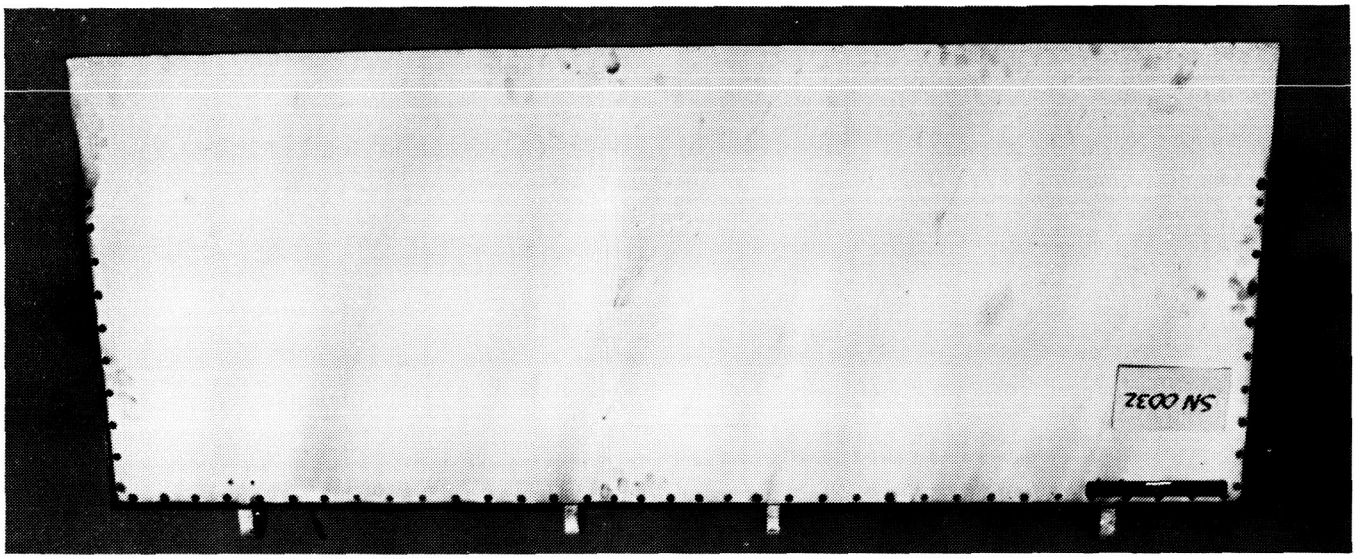

Figure 2. Upper Surface of Spoiler S/N 0032 After 12 yr of Service

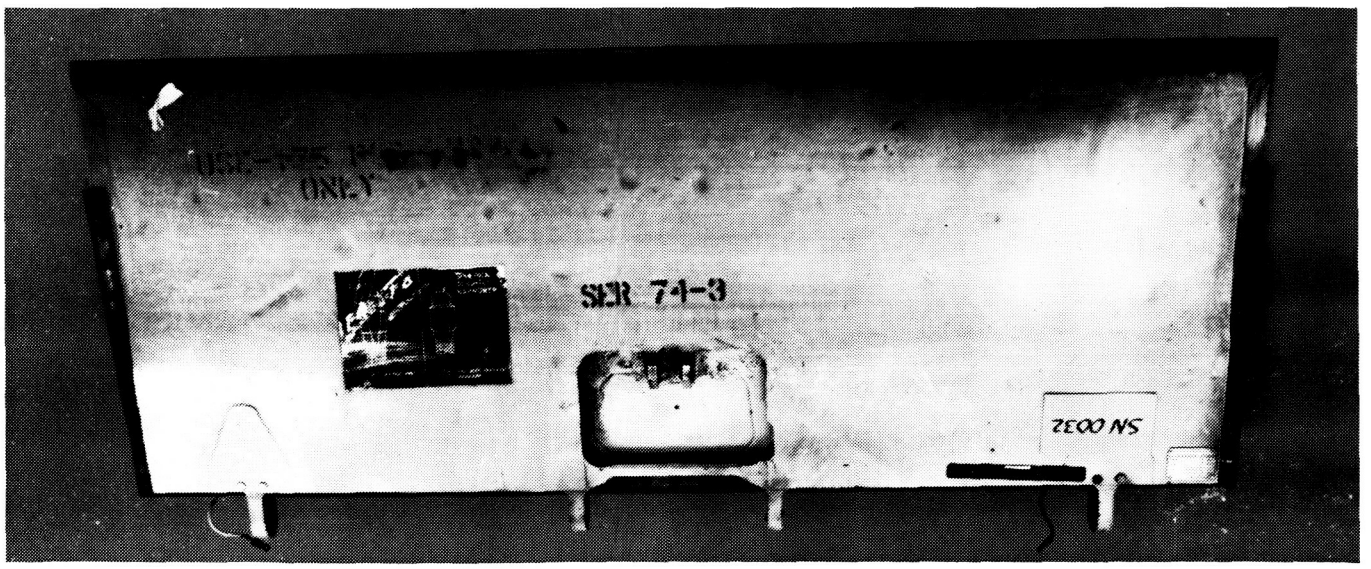

Figure 3. Lower Surface of Spoiler S/N 0032 After 12 yr of Service

Figures 4 and 5 are photographs of the upper and lower surfaces, respectively, of spoiler S/N 0072 after 12 years of service. This unit was clear of damage.

The upper and lower surfaces of spoiler S/N 0115 after 12 years of service are shown, respectively, on Figures 6 and 7. This unit was also clear of damage.

Table 4 gives data from all of the scheduled twelfth-year removals and summarizes the strength and stiffness data from the three units that were statically tested. Figure 8 shows the residual static strength data accumulated to date. Each symbol represents one test of a particular spoiler dash number (i.e., type of skin material) after a predesigned period of time. Initials near the symbols indicate the airline from which the spoiler was removed. The data are shown as residual strength ratio, where 1.0 is the original unexposed certification test value for each material system. The scatter band for a total of 16 ultimate tests run on unexposed -2 units is shown. Although limited to one production run of only one of the three types of material, the band provides some idea of the scatter that could be expected. The limit and ultimate load requirements for each material system are also shown in the figure. The units with known significant damage all failed above design limit load thus meeting safe operating criteria. Figures 9 through 11 are plots of the load-deflection data for the three 12-year spoilers reported in this document. Figure 12 shows the test setup. Load is applied to the upper surface through an evener system and load pad scheme. The load is then reacted at the four hinge points and the actuator rod end.

The failure loads for the twelfth-year test spoilers are on the high side of the baseline scatter band. In fact, two of the units failed at loads above the scatter band. There is no obvious explanation for this behavior. Calibration checks of the test equipment support the test data. The failure mode of the two high failure load spoilers was related to a higher energy failure mode. For these two spoilers the center hinge fitting was essentially rammed through the upper surface. Typical failures propagate from the center hinge-fitting-to-spar splice and are less catastrophic. Photographs of the spoilers after testing are shown in Figures 13 through 18. These spoilers had no apparent damage or degradation. As a last observation it should be noted that the baseline scatter band was generated from the test of 16 spoilers. With the testing of 36 spoilers after service exposure, the probability of excursions out of the baseline scatter band becomes greater.

Figure 12 shows the test setup. Load is applied to the upper surface through an evener system and load pad scheme. The load is then reacted at the four hinge points and the actuator rod end.

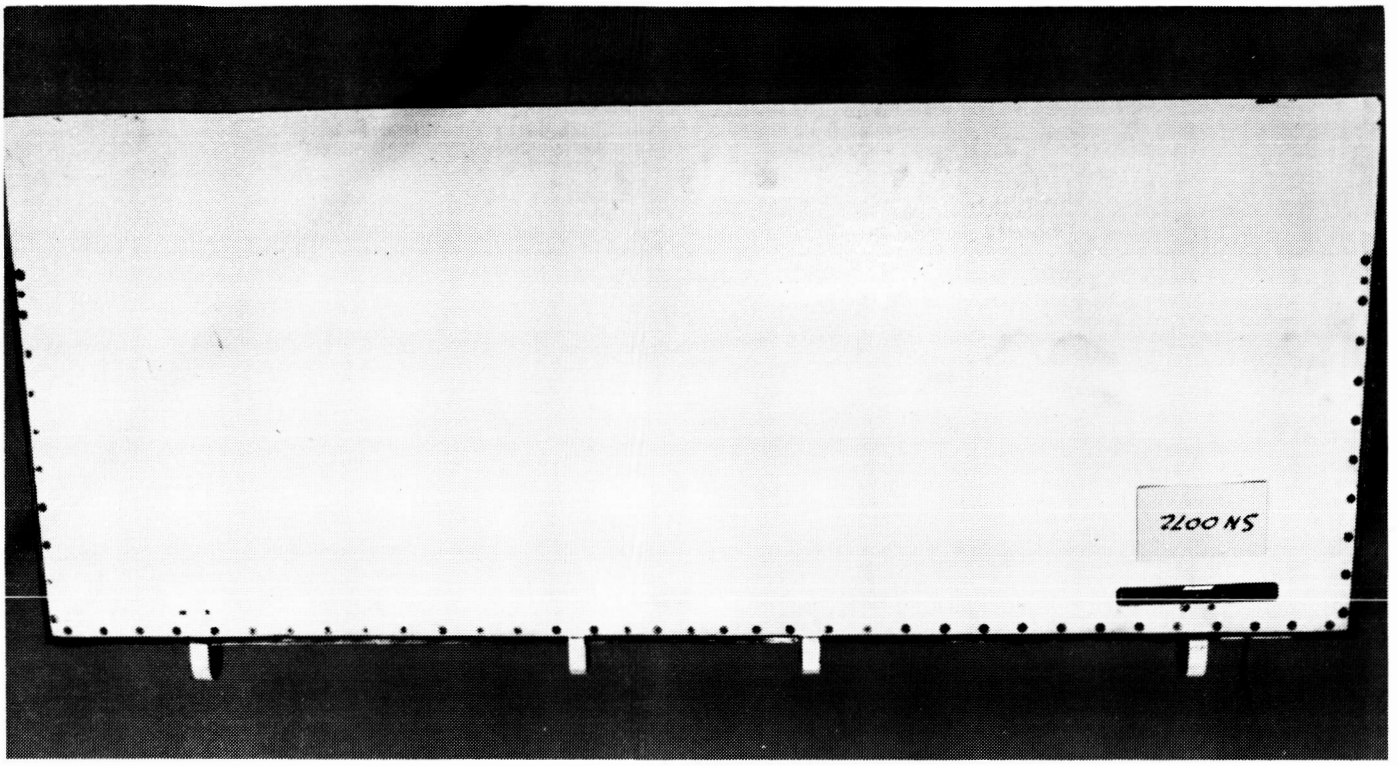

Figure 4. Upper Surface of Spoiler S/N 0072 After 12 yr of Service

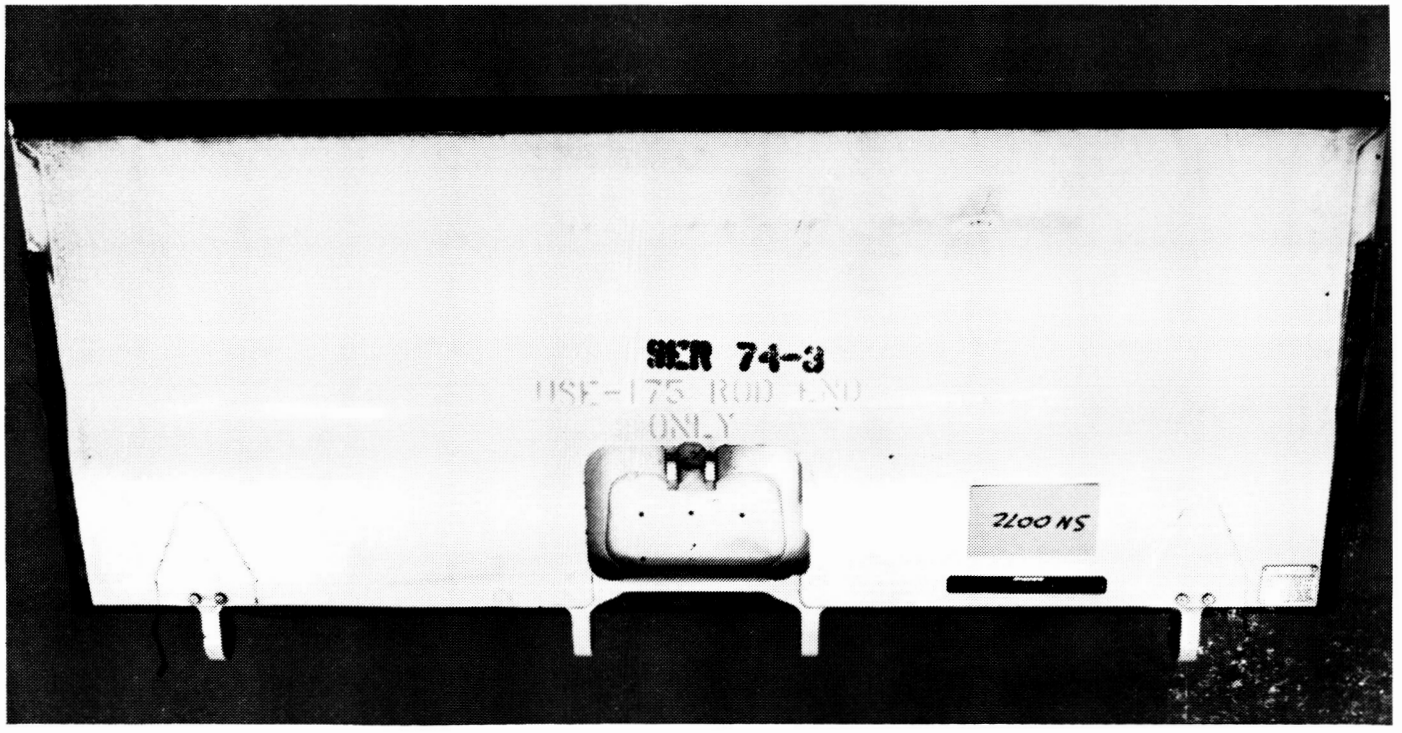

Figure 5. Lower Surface of Spoiler S/N 0072 After 12 yr of Service

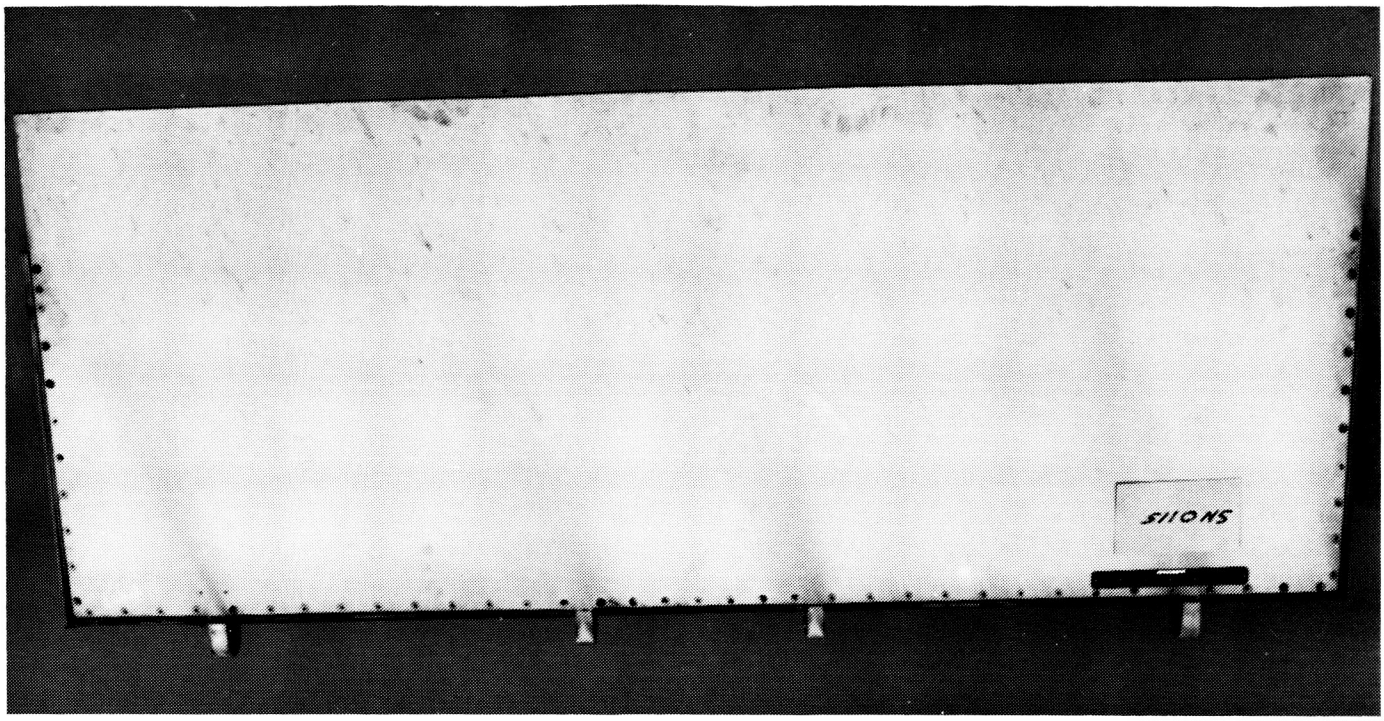

Figure 6. Upper Surface of Spoiler S/N 0115 After 12 yr of Service

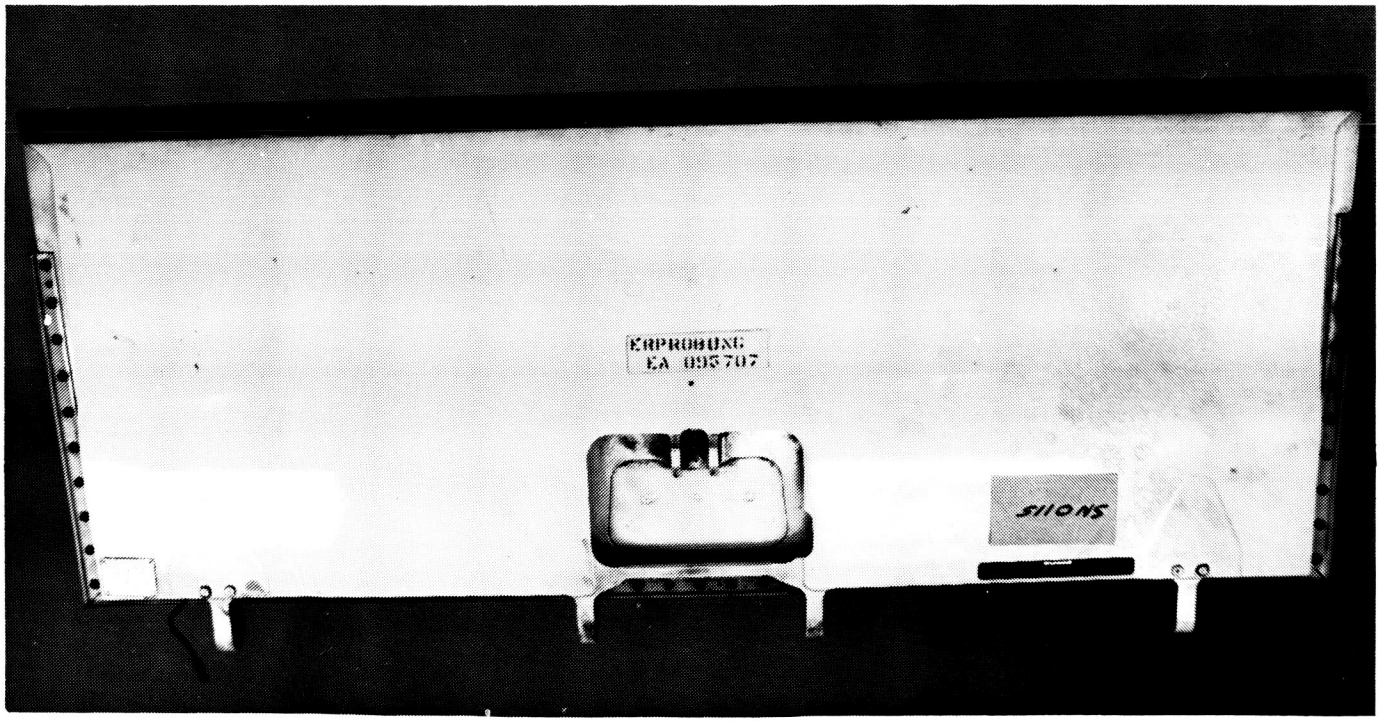

Figure 7. Lower Surface of Spoiler S/N 0115 After 12 yr of Service

Spoiler identification number	Airline	NDI Results	Failure load, percent DLL	Strength change, percent	Tip deflection change, percent	Time in service	Flight hours	Flight cycles
-1-0032	Piedmont	—	251	+2	-25	145 months 15 days	31,344	42,577
-2-0072	Piedmont	—	330	+14	-25	148 months 18 days	31,048	42,706
-3-0115	Lufthansa	—	274	+14	-17	143 months 0 days	27,637	32,563

Table 4. Summary Data From Scheduled Spoiler Removals (12th yr)

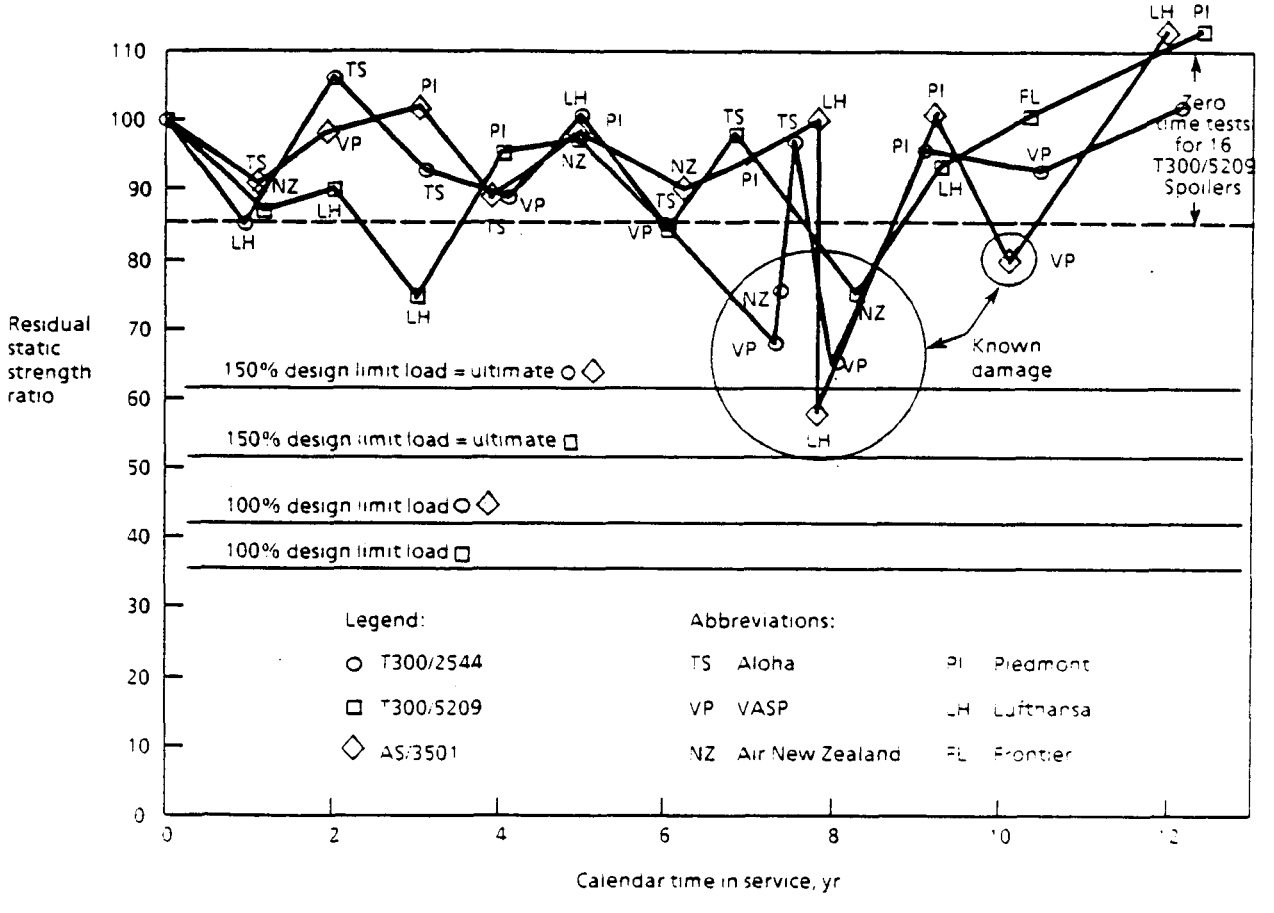

Figure 8. Summary of Residual Strength After Exposure

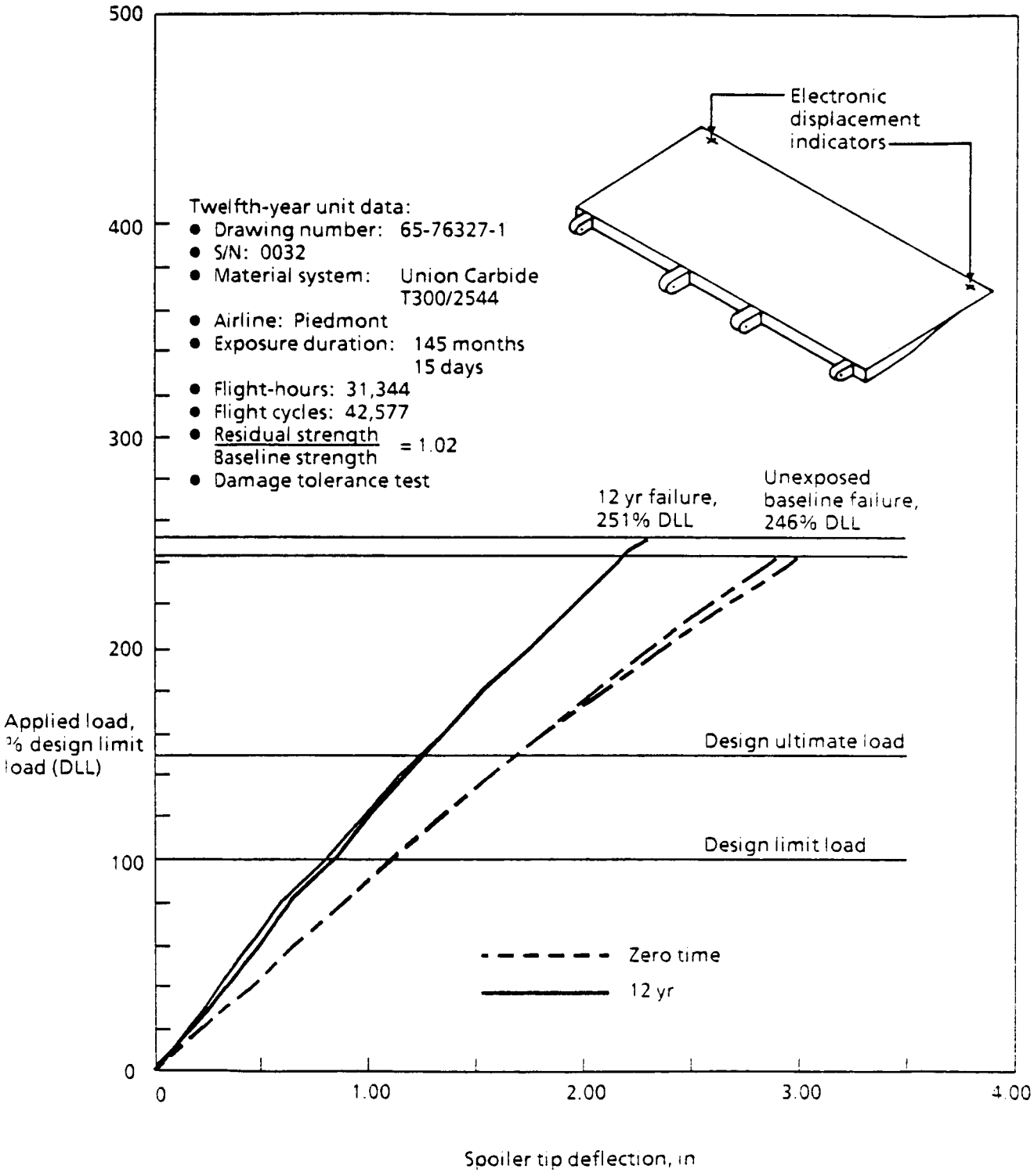

Figure 9. Residual Strength and Stiffness of Spoiler S/N 0032 After 12 yr of Service

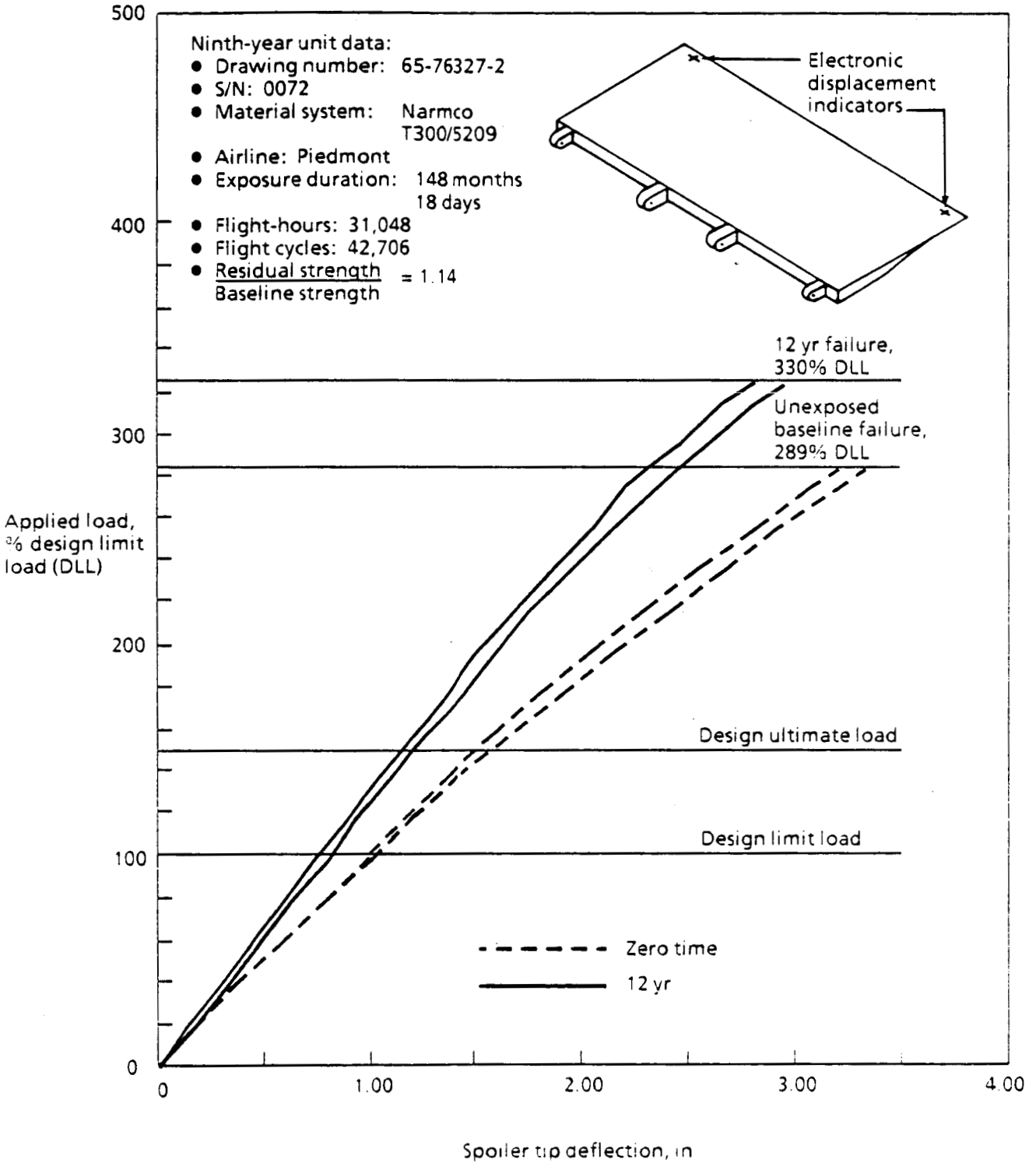

Figure 10. Hinge Detail of Spoiler S/N 0118 After 7 yr of Service

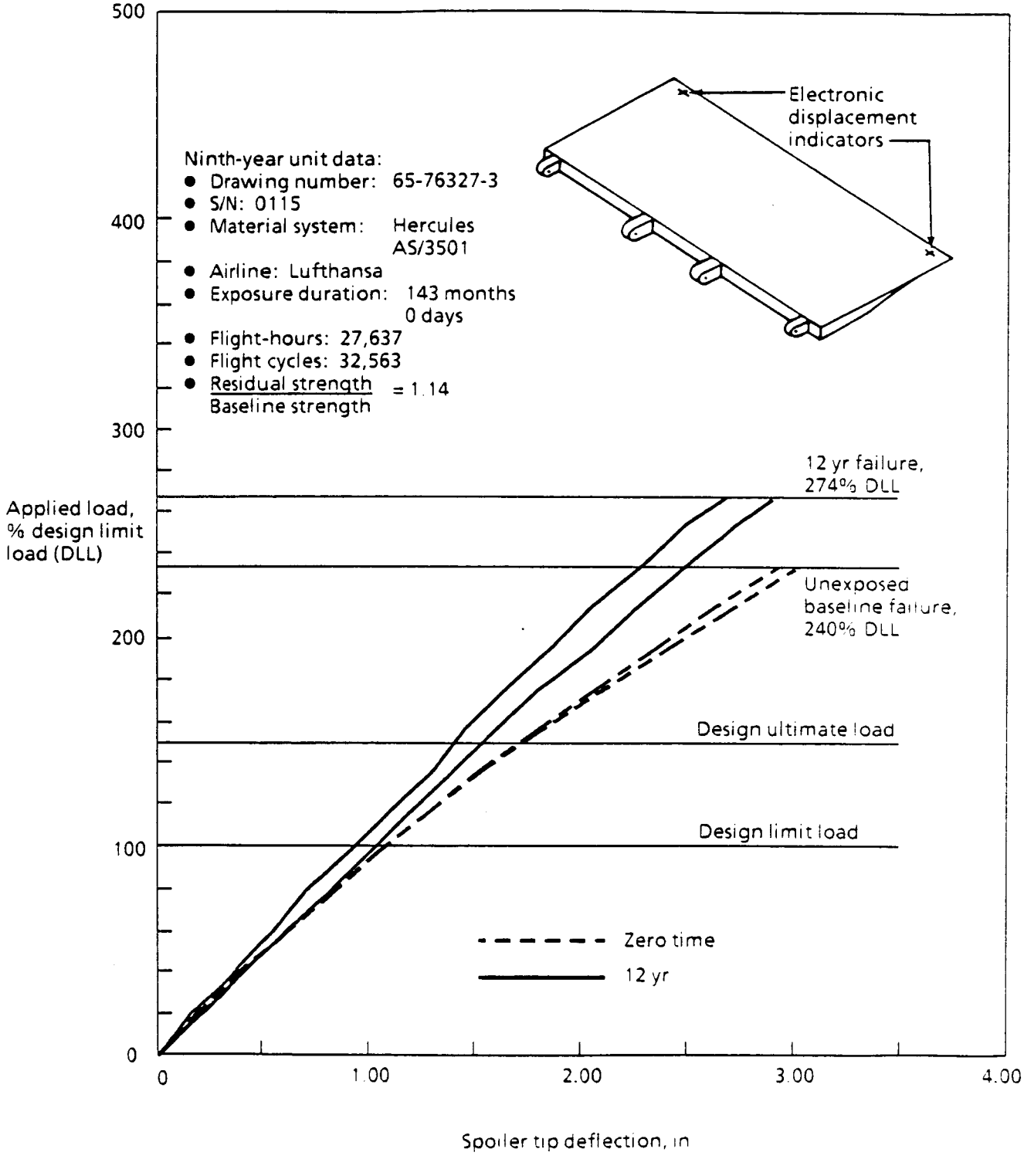

Figure 11. Residual Strength and Stiffness of Spoiler S/N 0115 After 12 yr of Service

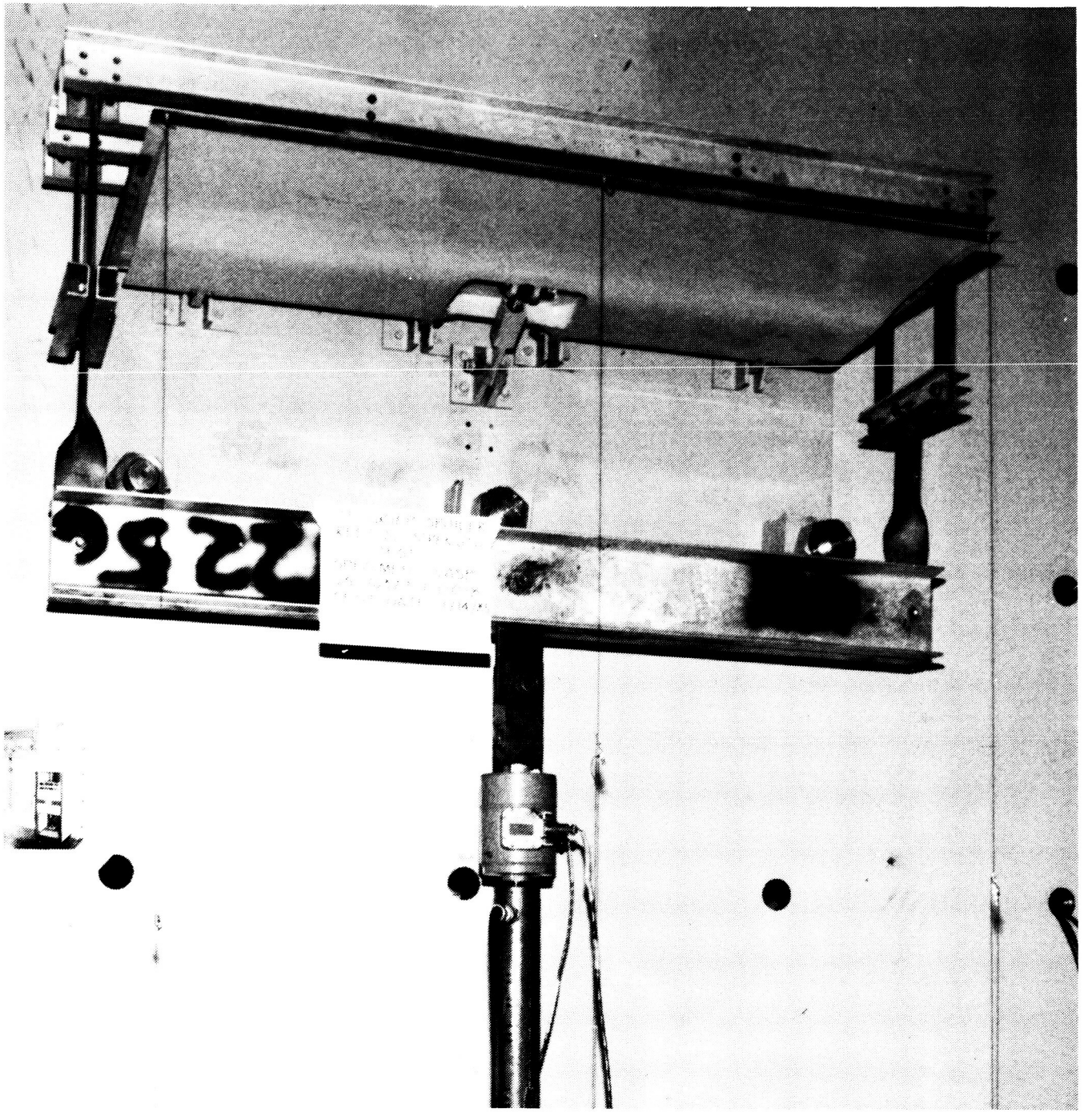

Figure 12. Spoiler Residual Strength Test Setup

Figure 13. Upper Surface of Spoiler S/N 0032 Following Residual Strength Test

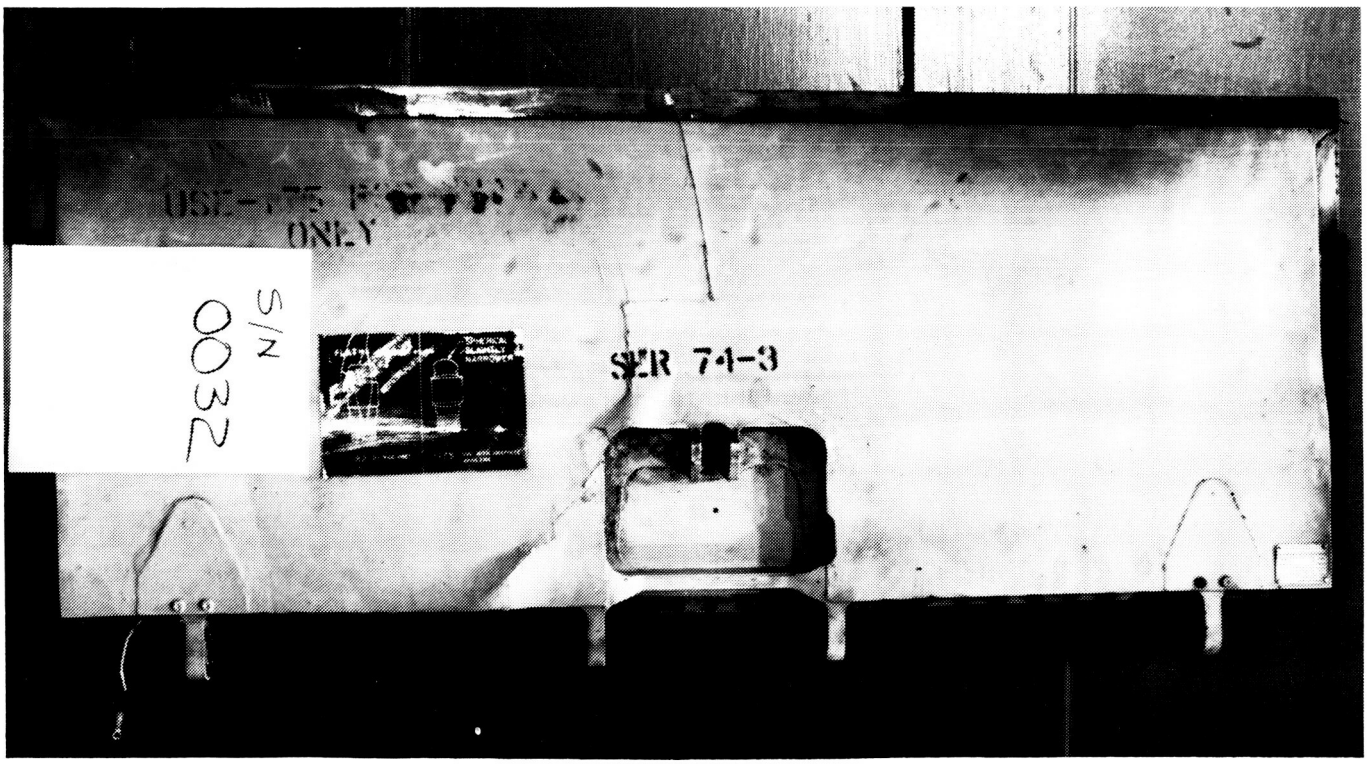

Figure 14. Lower Surface of Spoiler S/N 0032 Following Residual Strength Test

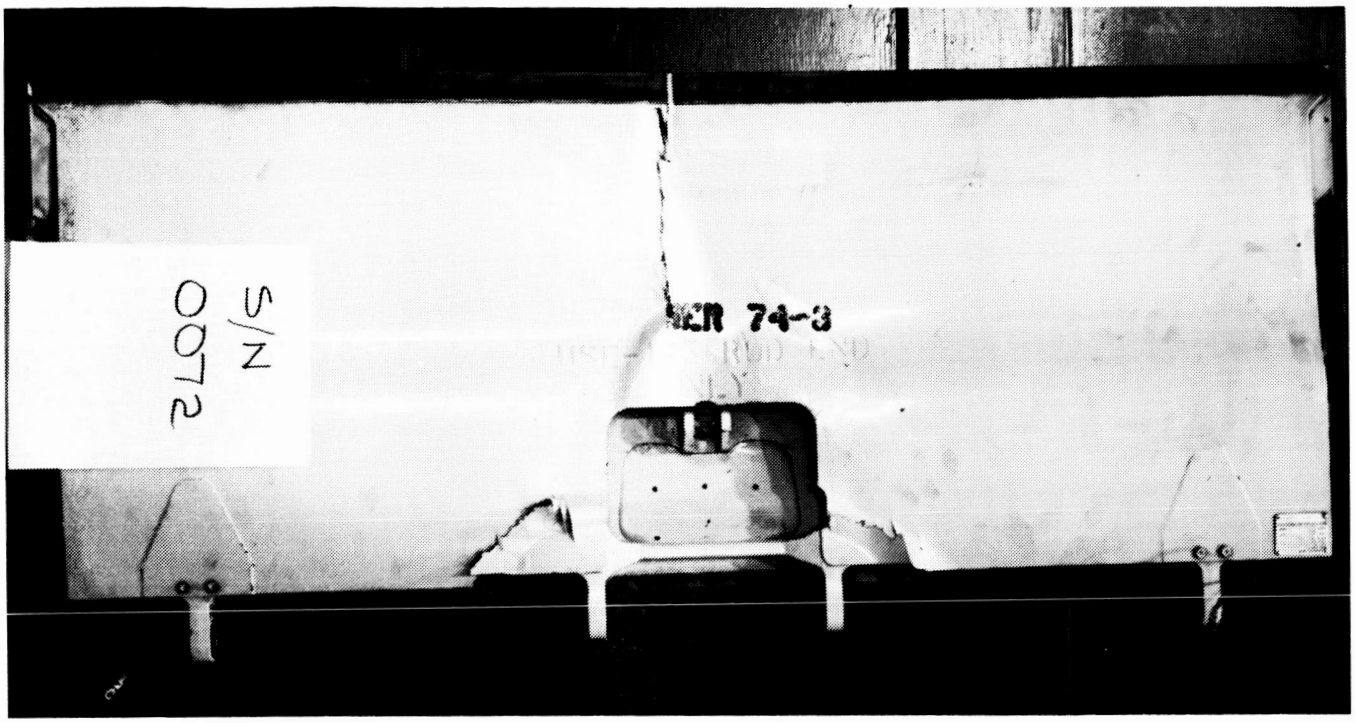

Figure 15. Lower Surface of Spoiler S/N 0072 Following Residual Strength Test

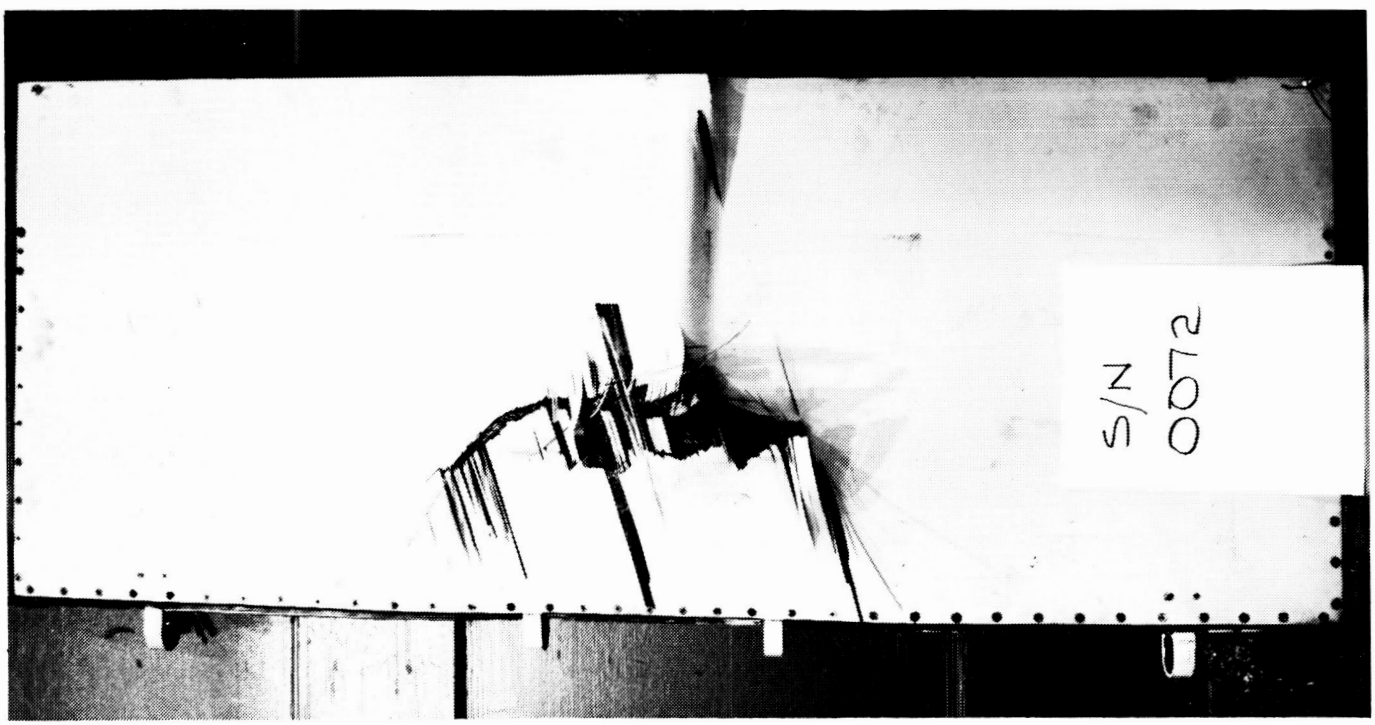

Figure 16. Upper Surface of Spoiler S/N 0072 Following Residual Strength Test

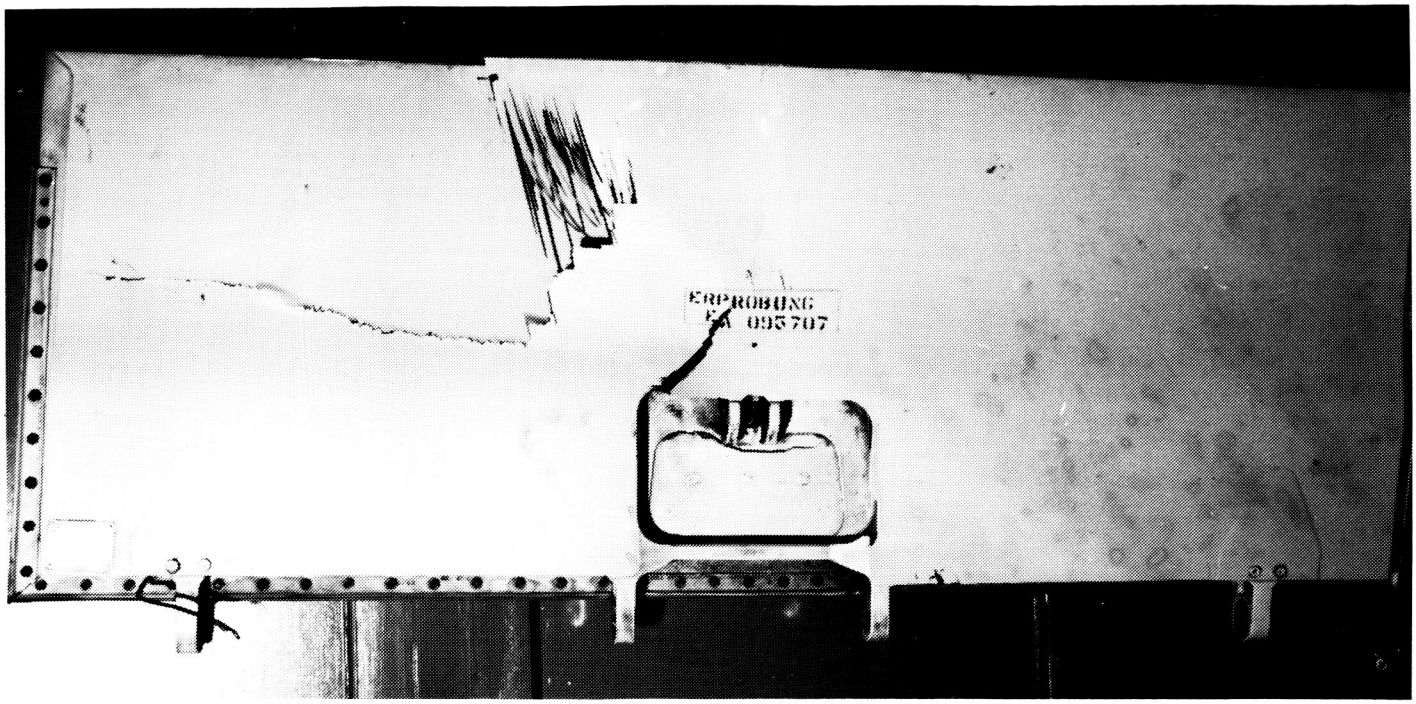

Figure 17. Lower Surface of Spoiler S/N 0115 Following Residual Strength Test

Figure 18. Upper Surface of Spoiler S/N 0115 Following Residual Strength Test

MOISTURE ABSORPTION CORE SAMPLING

As a continuation of the moisture sampling technique initiated and described in Reference 4, additional core plug samples were obtained from the spoiler panels that were static tested for residual strength. Each spoiler had three core plug samples removed. Each plug was a 2.25 in-dia cylindrical section approximately 0.4 in deep containing:

- Upper- and lower-surface paint films
- Upper and lower graphite-epoxy skins
- Two skin-to-core bonds
- The aluminum honeycomb core

All core specimens were subjected to a drying environment at 160°F. The samples were weighed in order to construct a final observed graphite-epoxy moisture content. This moisture content data is shown plotted against time on Figure 19.

The calculated moisture content was based on the observed weight changes during dryout and the following assumptions:

- The aluminum honeycomb core had no moisture.
- All three polymeric materials (paint, composite matrix, and adhesive bondlines) contained the same level of moisture

Moisture content (MC) was calculated by the following formula:

$$MC = \frac{(W)(W_{DM})}{(W_{DP})(W_{DC})} \times 100$$

Where:

W = observed weight loss (grams)
W_{DC} = weight of dry graphic-epoxy composite skins (grams)
W_{DP} = weight of dry polymeric components in total core plug sample (grams)
W_{DM} = weight of dry composite matrix material (grams)

The observed weight loss, W, represents the difference between the as-cut wet spoiler plug weight and the final dryout weight. Values for the paint weight (0.547g), the adhesive weight (6.653g), and the aluminum core weight (1.066g) were determined analytically or experimentally. Subtracting these values from the dry plug weight gave the weight of the dry graphite-epoxy composite skins. Using typical fiber volume fraction and densities, it was determined that 70% of the skin weight was due to the fiber, and the remaining 30% was epoxy matrix.

Use of this procedure to determine graphite-epoxy moisture content should result in a calculated value slightly higher than actual. Both the paint and the adhesive should have moisture contents higher than the epoxy matrix.

The moisture contents of the spoiler dryout specimens vary considerably over time relative to other moisture absorption studies (ref. 9, fig. 69). That study found moisture contents stabilizing at 1.90% for T300/2544, 1.00% for AS/3501, and 0.65% for T300/5209 and used 20-ply short-beam shear specimens that were unpainted. The difference in specimen geometry in terms of surface area, thickness, cut edge area, and surface finish may account for the different moisture absorption results. Especially important may be the thickness, in that the

this spoiler skin laminates allow a more rapid absorption-desorption cycle. As a result the measured moisture content may be more sensitive to the exact time in the seasonal cycle the spoiler was removed from service. Another factor is that over the years many of the spoilers have been painted and repainted resulting in variations in paint layer thickness from part to part. The absorption of moisture in the paint has been taken as a constant in this study. As a result changes in paint layer thickness may affect the final moisture content calculation.

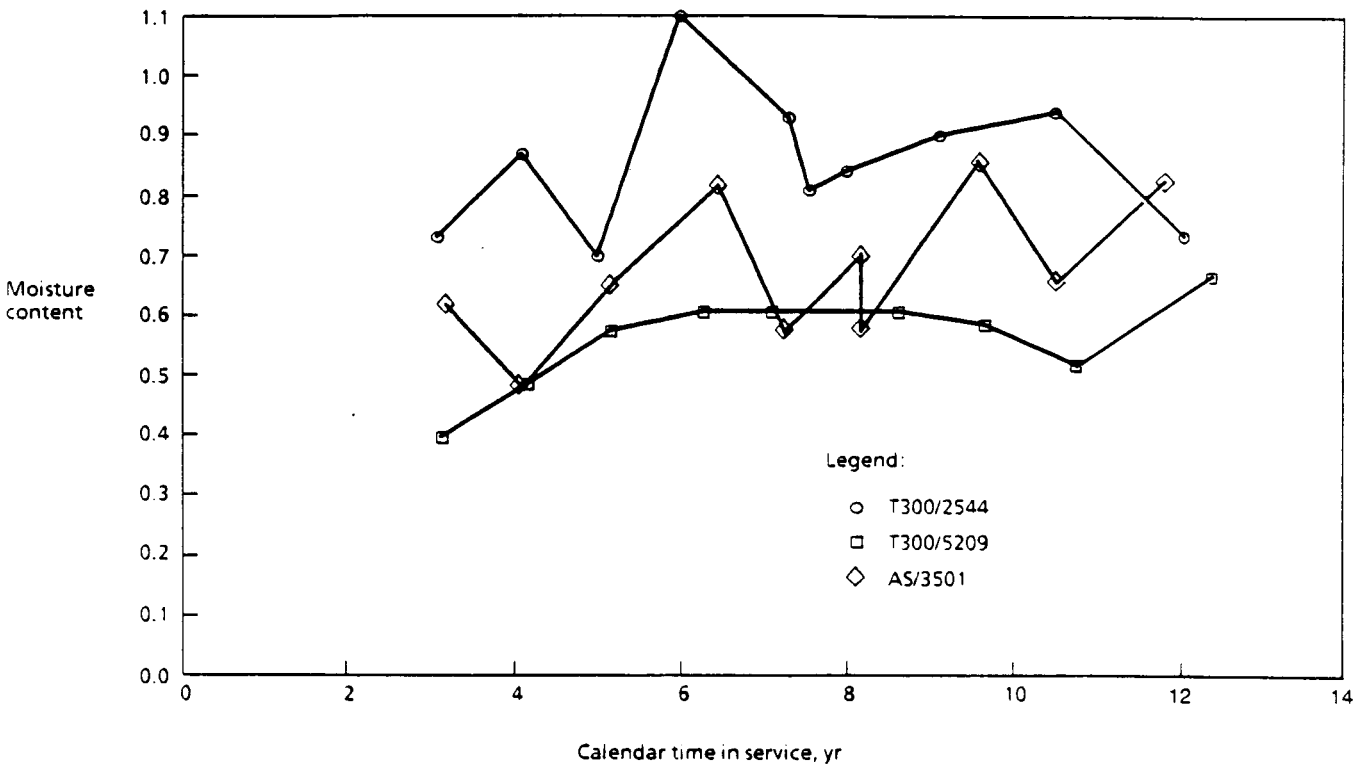

Figure 19. Moisture Weight Loss of Spoiler Core Samples

UNSCHEDULED SPOILER REMOVALS

The unscheduled removal of 7 spoilers occurred during this reporting period. Data for these spoilers are summarized in Table 5.

Table 6 is a summary of flight-service defects observed and shows the distribution and frequency of these defects. Because the rate of deterioration for defects is slow, one incident (for example, a rod-end blister) may be recorded on more than one annual inspection trip. Table 6 includes minor defects (primarily exfoliation corrosion) that are included to show how subsequent growth, or lack of growth, can be monitored. Although policies among the airlines differ, generally only a few defects would require repair during a scheduled maintenance break. Several defects would receive only a seal-and-monitor disposition, and some would never deteriorate enough to need repair.

Spoiler serial number	Airline	Date removed	Reason for removal	Disposition
0017	VASP	12-25-85	Spar exfoliation corrosion	Storage
0112	Lufthansa	04-29-86	Local outer ply delamination	Storage
0043	Air New Zealand	02-02-86	Aircraft retirement	ANZ stores
0074	Air New Zealand	02-02-86	Aircraft retirement	ANZ stores
0114	Lufthansa	05-23-85	Spar exfoliation corrosion	Storage
0019	Lufthansa	06-16-85	Rod-end blister	Storage
0007	Air New Zealand	04-07-86	Trailing edge damage	Storage

Table 5. Unscheduled Flight Spoiler Removals

		NUMBER OF NOTED DEFECTS									
	Number of spoilers	Rod-end blisters	Edge delaminations	Surface delaminations	Surface cracking	Upper-surface mechanical damage	Upper-surface natural and environmental damage	Lower-surface mechanical damage	Lower-surface natural and environmental damage	Aluminum doubler corrosion	Exfoliation corrosion corrosion damage
Frontier	6	5	1	0	0	0	0	0	0	3	4
New Zealand	16	9	1	2	0	1	0	2	0	2	20
Lufthansa	24	14	6	2	0	7	0	3	0	4	25
Aloha	17	8	1	1	0	2	0	0	0	4	9
Piedmont	32	9	5	1	3	10	0	1	0	18	38
VASP	16	11	7	4	0	5	0	3	0	9	23
Totals	111	56	21	10	3	25	0	9	0	40	119

Table 6. Spoiler Service Inspection Compilation (Cumulative 12 yr)

CONCLUSIONS

After twelve years of service, the Boeing/NASA 737 spoiler program can be classified as an unqualified success. The participating airlines remain enthusiastic and the level of participation has been limited only by continued airplane retirements and sales.

The knowledge base created as a result of this program has been instrumental in the advancement of composite material technology. Every aspect of developing and maintaining the composite spoilers in an airline environment provided experience applicable to subsequent programs. The design, analysis, production, and certification activities presented many new challenges that were met. The service experience provided information on durability and damage tolerance and required the development of new inspection and repair methods.

The years of flight service provided a good understanding of the type and frequency of damage events occurring in a variety of service environments. Inspection and repair techniques were also developed and refined.

Several design details proved to be inadequate as time progressed. These were the details around the actuator lug at the center hinge fitting (CHF) and the center hinge fitting to spar splice. The first detail allowed disbonding of the skin to the CHF due to actuator lug interference. In the aluminum design, the detail was identical but local yielding of the aluminum skin prevented disbonding. The solution for the graphite spoilers was the installation of a modified actuator lug to eliminate the interference. The CHF-spar splice detail involved a butt splice of the spar and CHF caps with the graphite skin bonded to the caps. As a result, the load path for spanwise bending was from one cap through the adhesive to the skin and back to the other cap through adhesive. Due to a strain mismatch between the skin and cap, the adhesive layer was worked beyond its capabilities under cyclic loading. As disbonding occurred, a moisture path was created between the aluminum and graphite. Moisture acts as a catalyst for the resulting galvanic corrosion. Several important things were learned from these occurrences. Corrosion in all cases was limited to the spar cap. Excursion into the core area was prevented by the thicker adhesive layer along the skin-to-core interference. Most importantly, it was found at both of these details that the rate of damage growth was extremely slow and easily detectable. Disbonds at the CHF-spar splice, for example, were usually detectable about two years before they would develop to a size requiring spoiler removal and repair. With proper sealing treatment, further growth can be prevented.

An ancillary project provided data on the effects of environmental exposure to graphite laminate specimens. Several hundred specimens were exposed on rooftops of airport buildings at participating airline bases. This provided a variety of exposure conditions over the 10-year duration of this project. Results of tests on returned specimens provide information on strength degradation, moisture absorption rates, and effects of ultraviolet exposure. The results show a stabilization of moisture absorption after about three years for the particular laminate geometry used. Saturation percentages are a function of material type and range from about 0.65 to 2.00 percent. Ultraviolet exposure proved to be degrading to the specimens as a function of the resin type. Most specimens were exposed without a protective paint surface. The mechanical properties tests indicate that the specimens have withstood exposure with no significant strength loss. This testing has been completed and is summarized in Reference 9.

A great number of damage events have been reported over the years of service. It is important to realize that while this number is large, it is also related to the level of intensity with which these parts have been monitored while in service. Numerous inspection trips involving an engineering evaluation of each spoiler were conducted. In addition, detailed evaluations are made on spoilers returned for structural testing. These activities combined with the airline's scheduled maintenance activities ensured that any problems or damage would be recorded in order to provide an accurate assessment of the spoilers' performance.

APPENDIX A

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
0			DEMONSTRATION UNIT AT NASA LANGLEY					00	00	6
0		0	0	0		0	0	0	0	0
1	06-27-74	5	5681	3056	--------	37912	46648	32231	43592	2
2			CERTIFICATION STATIC TEST UNIT					00	00	4
3	07-18-73	7	8095	12842	05-17-74	9018	14379	923	1537	0
3	05-17-74	6	9018	14379	--------	38033	46772	29015	32393	2
4	07-28-73	7	8161	12965	05-17-74	9018	14379	857	1414	0
4	05-17-74	6	9018	14379	--------	38033	46772	29015	32393	2
5	07-18-73	7	8095	12842	05-17-74	9018	14379	923	1537	0
5	05-17-74	6	9018	14379	04-08-78	18112	24432	9094	10053	0
5	02-15-79	6	20212	26856	04-24-80	23294	30267	3082	3411	0
5	08-06-82	2	29534	40417	09-01-84	33223	45292	3689	4875	0
5	04-01-85	2	34405	46864	--------	37015	50348	2610	3484	2
6	07-28-73	7	8161	12965	05-17-74	9018	14379	857	1414	0
6	05-17-74	6	9018	14379	--------	38033	46772	29015	32393	2
7	09-15-73	2	10861	15053	04-07-86	25715	38975	14854	23922	1
8	09-15-73	2	10861	15053	09-27-78	21603	29443	10742	14390	0
8	08-06-79	2	23465	31977	11-06-81	27997	38179	4532	6202	3
9	09-15-73	2	10861	15053	02-04-76	16147	22112	5286	7059	0
9	09-27-78	2	21603	29443	06-25-81	27258	37151	5655	7708	1
10	09-15-73	2	10861	15053	06-25-81	27258	37151	16397	22098	1
11	08-26-73	4	11274	15681	08-21-77	20307	26924	9033	11243	0
11	03-24-78	4	21658	28554	02-27-81	28562	36655	6904	8101	1
12	08-26-73	4	11274	15681	03-04-75	14694	19964	3420	4283	0
12	06-13-75	4	15148	20528	09-18-75	15793	21324	645	796	0
12	09-18-75	4	15940	21518	07-03-78	22297	29334	6357	7816	0
12	10-19-78	4	22954	30142	05-12-80	26719	34534	3765	4392	0
12	09-02-81	4	17	6	--------	12739	14837	12722	14831	2
13	08-26-73	4	11274	15681	05-06-78	21938	28901	10664	13220	0
13	10-06-78	4	20532	25040	10-20-78	20636	25143	104	103	0
13	10-25-78	4	22987	30176	02-27-81	28562	36655	5575	6479	1
14	08-26-73	4	11274	15681	07-29-74	13329	18216	2055	2535	3

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	INSTALL OR REINSTALL DATE	AIRLINE	HOURS	LANDINGS	CURRENT OR REMOVE DATE	HOURS	LANDINGS	NET HOURS	NET LANDINGS	REMARKS
15	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0
15	05-17-74	6	9399	14936	05-13-75	11689	17594	2290	2658	0
15	01-31-76	6	13411	19607	04-30-81	25917	33732	12506	14125	3
16	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0
16	05-17-74	6	9399	14936	09-04-77	17147	23719	7748	8783	3
17	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0
17	05-17-74	6	9399	14936	09-21-75	12432	18474	3033	3538	0
17	01-31-76	6	13411	19607	12-09-78	20050	26978	6639	7371	0
17	03-15-80	6	23355	30689	12-25-86	37550	46961	14195	16272	1
18	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0
18	05-17-74	6	9399	14936	05-13-75	11689	17594	2290	2658	0
18	01-31-76	6	13411	19607	10-03-84	34329	43357	20918	23750	3
19	10-02-73	4	11200	14884	01-01-82	29951	37516	18751	22632	0
19	02-11-82	4	29488	33283	06-16-85	38302	41701	8814	8418	1
20	10-02-73	4	11200	14884	09-27-78	22678	29128	11478	14244	3
21	10-02-73	4	11200	14884	03-29-75	14653	19211	3453	4327	0
21	08-02-75	4	15425	20178	10-12-78	22772	29241	7347	9063	0
21	08-10-79	4	24739	31517	01-01-82	29951	37516	5212	5999	0
21	02-23-82	4	12	4	--------	12833	11695	12821	11691	2
22	10-02-73	4	11200	14884	10-12-78	22772	29241	11572	14357	0
22	08-10-79	4	24739	31517	8-10-79	24739	31517	0	0	1
23	8-18-73	1	9207	24932	4-20-78	17722	48181	8515	23249	1
24	8-18-73	1	9207	24932	7-11-74	10974	29694	1767	4762	0
24	2-25-75	1	12071	32691	3-13-80	21114	57325	9043	24634	3
25	8-18-73	1	9207	24932	8-18-75	12964	35165	3757	10233	3
26	8-18-73	1	9207	24932	2-25-75	12071	32691	2864	7759	0
26	5-16-75	1	8287	14823	11-11-76	10395	20494	2108	5671	3
27	4-23-74	5	12329	20204	5-30-77	20488	32576	8159	12372	0
27	12-13-77	5	21916	34744	-------	45599	65216	23683	30472	2
28	2-28-74	5	13747	22449	2-24-75	16387	26396	2640	3947	0
28	6-17-75	5	17201	27670	-------	46788	67366	29587	39696	2
29	4-23-74	5	12329	20204	05-20-83	35762	53974	23433	33770	3
30	2-28-74	5	13747	22449	-------	46788	67366	33041	44917	2

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
31	2-28-74	5	13747	22449	8-11-79	27973	43614	14226	21165	0
31	04-14-82	5	34475	52801	--------	46788	67366	12313	14565	2
32	4-23-74	5	12329	20204	1-28-75	14411	23348	2082	3144	0
32	6-3-75	5	15259	24624	10-08-86	44521	64057	29262	39433	3
33	2-28-74	5	13747	22449	02-21-82	34111	52266	20364	29817	3
34	4-23-74	5	12329	20204	-------	45599	65216	33270	45012	2
35	6-27-74	5	5681	3056	4-18-75	7673	5964	1992	2908	0
35	8-15-75	5	8542	7300	-------	37912	46648	29370	39348	2
36	6-27-74	5	5681	3056	4-16-75	7663	5945	1982	2889	0
36	8-15-75	5	8542	7300	--------	37912	46648	29370	39348	2
37	6-27-74	5	5681	3056	-------	37912	46648	32231	43592	2
38	10-25-74	1	11340	30745	05-09-82	24088	65685	12748	34940	3
39			DOES NOT EXIST							5
40			DOES NOT EXIST							5
41			CERTIFICATION STATIC TEST UNIT					00	00	4
42	7-26-73	7	5003	8092	9-30-75	9600	16525	4597	8433	0
42	9-30-75	3	9600	16525	-------	42575	50715	32975	34190	2
43	7-25-73	7	4993	8068	9-30-75	9600	16525	4607	8457	0
43	9-30-75	3	9600	16525	5-28-80	23512	31825	13912	15300	0
43	05-10-82	2	28784	39210	04-04-85	34407	46881	5623	7671	0
43	05-25-85	2	34687	47278	02-04-86	36195	49342	1508	2064	3
44	7-26-73	7	5003	8092	9-30-75	9600	16525	4597	8433	0
44	9-30-75	3	9600	16525	12-29-76	13201	20370	3601	3845	0
44	8-3-77	3	15025	22485	06-25-84	35164	43974	20139	21489	3
45	7-25-73	7	4993	8068	7-14-74	6895	11280	1902	3212	0
45	1-15-76	3	10064	16998	4-24-78	17369	24969	7305	7971	0
45	4-9-79	2	22504	30331	3-19-81	26488	35711	3984	5380	1
46	8-8-73	1	6447	9087	1-11-78	13058	26664	6611	17577	0
46	1-11-78	1	20014	30447	5-16-79	22540	37358	2526	6911	0
46	10-15-80	1	22118	59759	2-26-81	22613	61420	495	1661	0
46	2-26-81	1	6391	17574	03-21-82	8167	22328	1776	4754	1

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
47	8-8-73	1	6447	9087	1-7-76	10256	19089	3809	10002	0
47	8-16-76	3	14728	16350	1-9-78	19153	21328	4425	4978	0
47	4-24-78	3	17409	25010	4-20-81	26282	34352	8873	9342	0
47	04-08-83	2	30525	41316	--------	36370	49037	5845	7721	2
48	8-8-73	1	6447	9087	2-25-75	9103	16022	2656	6935	0
48	5-16-75	1	8287	14823	8-17-77	11473	23389	3186	8566	0
48	8-17-77	1	15912	36880	10-26-81	23575	50737	7663	13857	1
49	8-8-73	1	6447	9087	4-13-77	12050	23911	5603	14824	0
49	1-11-78	1	20014	30447	4-2-80	23688	40420	3674	9973	0
49	4-8-80	1	19905	53977	3-10-81	21413	58105	1508	4128	3
50	7-23-73	2	10539	14075	1-28-76	15771	21303	5232	7228	0
50	09-29-78	2	21534	29018	06-01-82	28962	39171	7428	10153	1
51	07-23-73	2	10539	14075	10-18-77	19444	26204	8905	12129	0
51	4-3-78	2	20435	27564	04-18-82	28671	38763	8236	11199	3
52	7-23-73	2	10539	14075	2-27-75	14057	18964	3518	4889	0
52	6-8-75	2	14707	19835	11-16-78	21757	29355	7050	9520	0
52	2-28-80	2	24447	32979	-----	36370	49037	11923	16058	2
53	7-23-73	2	10539	14075	9-24-74	13138	17747	2599	3672	3
54	9-6-73	4	11152	15328	9-6-76	17899	23824	6747	8496	3
55	9-6-73	4	11152	15328	08-28-81	29501	37306	18349	21978	0
55	11-22-81	4	311	333	--------	12579	14164	12268	13831	2
56	9-6-73	4	11152	15328	08-28-81	29501	37306	18349	21978	0
56	10-05-81	4	12	3	--------	12579	14164	12567	14161	2
57	9-6-73	4	11152	15328	9-7-75	15633	20997	4481	5669	3
58	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
58	5-17-74	6	9402	15241	-----	39742	49066	30340	33825	2
59	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
59	5-17-74	6	9402	15241	1-14-75	10900	17164	1498	1923	0
59	1-31-76	6	13181	19621	9-1-80	24475	31957	11294	12336	3
60	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
60	5-17-74	6	9402	15241	9-2-76	14715	21102	5313	5861	0
60	11-17-77	6	17529	24227	-----	39742	49066	22213	24839	2
61	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
61	5-17-74	6	9402	15241	-----	39742	49066	30340	33825	2

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
62	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
62	02-23-82	4	12	3	--------	12833	11695	12821	11692	2
63	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
63	02-23-82	4	12	3	--------	12833	11695	12821	11692	2
64	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
64	02-05-82	4	29488	33283	04-09-82	29908	33654	420	371	0
64	04-20-82	4	1271	1408	05-26-83	3820	4355	2549	2947	3
65	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
65	02-23-82	4	12	3	--------	12833	11695	12821	11692	2
66	9-29-73	2	10787	14648	2-27-75	14184	19120	3397	4472	0
66	6-7-75	2	14602	19678	10-28-77	19605	26654	5003	6976	0
66	4-6-78	2	20556	27959	5-2-79	22584	30603	2028	2644	0
66	11-14-80	2	25702	34889	05-10-82	28784	39210	3082	4321	0
66	06-08-82	2	28959	39446	08-01-83	30925	42208	1966	2762	0
66	11-30-84	2	29041	40481	--------	32094	44553	3053	4072	2
67	9-29-73	2	10787	14648	9-15-78	21231	28840	10444	14192	3
68	9-29-73	2	10787	14648	6-16-80	25009	33910	14222	19262	0
68	08-04-82	2	29217	39803	07-10-84	32904	44872	3687	5069	0
68	01-12-85	2	33991	46309	--------	37015	50348	3024	4039	2
69	9-29-73	2	10787	14648	06-16-81	26913	36522	16126	21874	1
70	3-4-74	5	13908	22649	3-6-81	31634	49004	17726	26355	0
70	04-21-82	5	34592	53159	--------	46411	67144	11819	13985	2
71	3-4-74	5	13908	22649	3-6-78	24332	38438	10424	15789	3
72	3-4-74	5	13908	22649	3-11-79	26978	42326	13070	19677	0
72	6-28-79	5	27721	43379	11-05-86	45699	66408	17978	23029	3
73	8-15-74	5	15070	24630	-----	46788	67867	31718	43237	2
74	3-4-74	5	13908	22649	4-27-76	19600	31548	5692	8899	0
74	8-16-76	3	14728	16350	1-9-78	19153	21328	4425	4978	0
74	4-11-79	2	22467	30441	5-2-79	22584	30603	117	162	0
74	2-23-81	2	26378	35804	02-04-86	36195	49342	9817	13538	1
75	8-15-74	5	15070	24630	-----	46788	67867	31718	43237	2
76	8-15-74	5	15070	24630	-----	46788	67867	31718	43237	2
77	8-15-74	5	15070	24630	-----	46788	67867	31718	43237	2

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
78	10-17-73	1	9343	25410	10-24-74	11340	30728	1997	5318	0
78	2-25-75	1	9103	16022	1-11-78	13058	26664	3955	10642	0
78	1-11-78	1	20014	30447	4-2-80	23688	40420	3674	9973	0
78	04-08-80	1	19905	53977	11-01-82	23349	63296	3444	9319	0
78	04-08-83	2	30525	41316	--------	36370	49037	5845	7721	2
79			DOES NOT EXIST							5
80			DOES NOT EXIST							5
81			CERTIFICATION STATIC TEST UNIT					00	00	4
82	9-12-73	4	11560	16962	07-20-81	29680	46880	18120	29918	3
83	9-12-73	4	11560	16962	5-17-75	15286	22013	3726	5051	0
83	9-12-76	4	16901	26080	07-20-81	29680	46880	12779	20800	0
83	09-02-81	4	17	6	--------	12739	14837	12722	14831	2
84	9-12-73	4	11560	16962	5-17-75	15286	22013	3726	5051	0
84	12-19-75	4	16576	25672	07-20-81	29680	46880	13104	21208	0
84	08-24-81	4	11	3	04-26-83	3920	4447	3909	4444	1
85	9-12-73	4	11560	16962	9-4-75	15896	23901	4336	6939	0
85	2-12-76	4	16901	26080	07-20-81	29680	46880	12779	20800	0
85	09-02-81	4	17	6	02-02-82	1016	1117	999	1111	3
86	9-22-73	2	5587	8565	11-30-84	29041	40481	23454	31916	0
86	03-29-85	2	34269	46270	--------	36370	49037	2101	2767	2
87	9-22-73	2	5587	8565	6-11-75	9516	13797	3929	5232	0
87	12-19-75	2	10647	15393	6-16-80	20322	28691	9675	13298	3
88	9-22-73	2	5587	8565	6-11-75	9516	13797	3929	5232	0
88	12-19-75	2	10647	15393	11-22-76	12556	18020	1909	2627	0
88	9-9-77	2	14149	20361	9-24-80	20796	29307	6647	8946	1
89	9-22-73	2	5587	8565	6-21-74	7272	10794	1685	2229	0
89	2-13-75	2	8771	12820	11-22-76	12556	18020	3785	5200	0
89	9-9-77	2	14149	20361	2-12-78	15100	21677	951	1316	0
89	2-14-79	2	17400	24707	06-11-81	22003	30940	4603	6233	0
89	07-21-81	2	22218	31229	--------	32094	44553	9876	13324	2
90	8-15-73	1	5623	7992	5-2-74	6788	10937	1165	2945	0
90	10-24-74	1	11334	30728	4-4-79	19300	52783	7966	22055	1
91	8-15-73	1	5623	7992	5-16-75	8287	14823	2664	6831	0
91	8-18-75	1	12964	35165	12-18-75	13572	36811	608	1646	0
91	12-18-75	1	13572	36811	12-13-78	18925	51459	5353	14648	0
91	12-12-79	1	20693	56210	2-26-81	22613	61420	1920	5210	0
91	2-26-81	1	6391	17574	04-02-82	8185	22377	1794	4803	0
91	01-12-85	2	33991	46309	--------	37015	50348	3024	4039	2

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
92	8-15-73	1	5623	7992	8-18-77	11480	23406	5857	15414	0
92	8-18-77	1	15916	36893	10-26-81	23575	50737	7659	13844	0
92	05-06-83	2	30532	41749	01-12-85	33991	46309	3459	4560	0
92	04-01-85	2	34450	46920	--------	37015	50348	2565	3428	2
93	3-20-74	5	13879	22839	4-1-75	16461	26759	2582	3920	0
93	8-3-75	5	17333	28122	3-30-77	21797	34851	4464	6729	0
93	2-8-78	5	24051	38238	-----	46488	67359	22437	29121	2
94	3-20-74	5	13879	22839	4-1-75	16461	26759	2582	3920	0
94	8-3-75	5	17333	28122	-----	46488	67359	29155	39237	2
95	3-20-74	5	13879	22839	-----	46488	67359	32609	44520	2
96	3-20-74	5	13879	22839	3-20-79	26988	42537	13109	19698	3
97	12-21-77	1	16360	38058	10-26-81	23575	50737	7215	12679	1
98	9-25-73	1	9244	25150	05-12-82	24093	65702	14849	40552	0
98	05-20-83	2	25906	36352	--------	32094	44553	6188	8201	2
99	3-21-74	5	10290	15517	-----	42903	60706	32613	45189	2
100	4-11-74	5	12641	20584	-----	45559	64843	32918	44259	2
101	3-21-74	5	10290	15517	-----	42903	60706	32613	45189	2
102	3-21-74	5	10290	15517	06-08-83	33885	49939	23595	34422	3
103	4-11-74	5	12641	20584	4-17-80	28250	43515	15609	22931	1
104	9-25-73	1	9244	25150	10-25-74	11340	30745	2096	5595	3
105	9-25-73	1	9244	25150	10-17-73	9343	25410	99	260	0
105	6-7-74	1	6916	11247	5-16-75	8287	14823	1371	3576	1
106	8-15-73	1	5623	7992	8-17-77	11473	23389	5850	15397	0
106	8-17-77	1	15912	36880	10-26-81	23575	50737	7663	13857	1
107	9-25-73	1	9244	25150	8-17-77	16527	45144	7283	19994	3
108	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
108	5-17-74	6	9568	15160	11-17-76	15342	21726	5774	6566	0
108	11-21-77	6	17818	24525	10-04-84	34228	42895	16410	18370	3
109	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
109	5-17-74	6	9568	15160	7-29-75	12174	18313	2606	3153	3
110	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
110	5-17-74	6	9568	15160	-----	39031	48238	29463	33078	2

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
111	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
111	5-17-74	6	9568	15160	7-29-75	12174	18313	2606	3153	0
111	1-31-76	6	13369	19647	4-10-78	18669	25467	5300	5820	0
111	12-14-78	6	20304	27301	10-04-84	34228	42895	13924	15594	3
112	11-13-73	4	11587	16011	6-20-75	15179	20569	3592	4558	0
112	12-18-75	4	16309	21974	03-02-81	28405	36410	12096	14436	0
112	08-24-81	4	11	3	04-29-86	10845	12300	10834	12297	1
113	11-13-73	4	11587	16011	03-02-81	28405	36410	16818	20399	0
113	08-24-81	4	11	3	--------	12882	14490	12871	14487	2
114	11-13-73	4	11587	16011	3-9-75	14601	19849	3014	3838	0
114	6-20-75	4	15179	20569	9-30-80	27495	35391	12316	14822	0
114	08-02-82	4	2189	2488	05-23-85	8654	10331	6465	7843	1
115	11-13-73	4	11587	16011	11-9-76	18322	24487	6735	8476	0
115	3-26-77	4	19208	25567	03-02-81	28405	36410	9197	10843	0
115	08-24-81	4	11	3	09-22-86	11716	13247	11705	13244	3
116	3-21-74	5	10290	15517	4-4-77	18529	28010	8239	12493	3
117	4-11-74	5	12641	20584	-------	45559	64843	32918	44259	2
118	4-11-74	5	12641	20584	5-18-76	18147	29062	5506	8478	0
118	12-17-76	5	19709	31351	11-11-81	32570	49333	12861	17982	3

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

AIRLINE CODE (JALC)
ALOHA=1, AIR NEW ZEALAND=2, FRONTIER=3, LUFTHANSA=4, PEIDMONT=5, VASP=6, PSA=7

REMARKS CODE
0=OLD DATA, 1=NO LONGER ACTIVE, 2=CURRENTLY ACTIVE, 3= OUT FOR REPAIR OR EVALUATION

4= CERTIFICATION STATIC TEST,5= DOES NOT EXIST,6= DEMO. UNIT AT NASA

TOTAL NET HOURS FOR SPOILERS ON ALOHA= 174791 TOTAL NET LANDINGS FOR SPOILERS ON ALOHA= 444994

TOTAL NET HOURS FOR SPOILERS ON AIR NEW ZEALAND= 305207 TOTAL NET LANDINGS FOR SPOILERS ON AIR NEW ZEALAND= 417074

TOTAL NET HOURS FOR SPOILERS ON FRONTIER= 96055 TOTAL NET LANDINGS FOR SPOILERS ON FRONTIER= 102093

TOTAL NET HOURS FOR SPOILERS ON LUFTHANSA= 521260 TOTAL NET LANDINGS FOR SPOILERS ON LUFTHANSA= 634113

TOTAL NET HOURS FOR SPOILERS ON PIEDMONT= 866627 TOTAL NET LANDINGS FOR SPOILERS ON PEIDMONT= 1193016

TOTAL NET HOURS FOR SPOILERS ON VASP= 345921 TOTAL NET LANDINGS FOR SPOILERS ON VASP= 388141

TOTAL NET HOURS FOR SPOILERS ON PSA= 29747 TOTAL NET LANDINGS FOR SPOILERS ON PSA= 51521

TOTAL NET HOURS FOR SPOILERS 1 THRU 38= 779887 TOTAL NET LANDINGS FOR SPOILERS 1 THRU 38= 1056103

TOTAL NET HOURS FOR SPOILERS 41 THRU 78= 815005 TOTAL NET LANDINGS FOR SPOILERS 41 THRU 78= 1087722

TOTAL NET HOURS FOR SPOILERS 81 THRU 118= 744716 TOTAL NET LANDINGS FOR SPOILERS 81 THRU 118= 1087127

TOTAL NET HOURS= 2339608 TOTAL NET LANDINGS= 3230952

CURRENT SPOILER FLIGHT-HOURS AND LANDING DATA

S/N	SPOILER FLIGHT HOURS AND LANDINGS HOURS	LANDINGS
1	32231	43592
2	0	0
3	29938	33930
4	29872	33807
5	19398	23360
6	29872	33807
7	14854	23922
8	15274	20592
9	10941	14767
10	16397	22098
11	15937	19344
12	26909	32118
13	16343	19802
14	2055	2535
15	15544	18008
16	8496	10008
17	24615	28406
18	23956	27633
19	27565	31050
20	11478	14244
21	28833	31080
22	11572	14357
23	8515	23249
24	10810	29396
25	3757	10233
26	4972	13430
27	31842	42844
28	32227	43643
29	23433	33770
30	33041	44917
31	26539	35730
32	31344	42577
33	20364	29817
34	33270	45012
35	31362	42256
36	31352	42237
37	32231	43592
38	12748	34940
39	0	0
40	0	0
41	0	0
42	37572	42623
43	26050	33492
44	28337	33767
45	13191	16563
46	11408	30903
47	22952	32043
48	13505	29358
49	10785	28925
50	12660	17381
51	17141	23328
52	22491	30467
53	2599	3672
54	6747	8496
55	30617	35809
56	30916	36139
57	4481	5669
58	31266	35422
59	13718	15856

S/N	SPOILER FLIGHT HOURS AND LANDINGS HOURS	LANDINGS
60	28452	32297
61	31266	35422
62	31454	34112
63	31454	34112
64	21602	25738
65	31454	34112
66	18529	25247
67	10444	14192
68	20933	28370
69	16126	21874
70	29545	40340
71	10424	15789
72	31048	42706
73	31718	43237
74	20051	27577
75	31718	43237
76	31718	43237
77	31718	43237
78	18915	42973
79	0	0
80	0	0
81	0	0
82	18120	29918
83	29227	40682
84	20739	30703
85	18114	28850
86	25555	34683
87	13604	18530
88	12485	16805
89	20900	28302
90	9131	25000
91	15363	37177
92	19540	37246
93	29483	39770
94	31737	43157
95	32609	44520
96	13109	19698
97	7215	12679
98	21037	48753
99	32613	45189
100	32918	44259
101	32613	45189
102	23595	34422
103	15609	22931
104	2096	5595
105	1470	3836
106	13513	29254
107	7283	19994
108	23131	26385
109	3553	4602
110	30410	34527
111	22777	26016
112	26522	31291
113	29689	34886
114	21795	26503
115	27637	32563
116	8239	12493
117	32918	44259
118	18367	26460

APPENDIX B

NASA/BOEING 727 GRAPHITE COMPOSITE ELEVATOR SERVICE HISTORY

Five shipsets of 727 graphite composite elevators were fabricated for Contract NAS1-14952 with the prime objective of establishing and demonstrating the structural integrity, operating-life characteristics, and manufacturing cost of composite structures.

The five shipsets (10 units) entered service with United Airlines in 1980. A summary of accumulated hours and landings is shown in Table B1.

Two separate ground landing incidents resulted in the damage and subsequent removal of two units. These units were subsequently repaired at the United Maintenance Base and are awaiting reinstallation. Lightning strikes or exits have resulted in the required repair of several units. These repairs were minor and performed with the units remaining on the aircraft.

APPENDIX B

CURRENT ELEVATOR FLIGHT-HOURS AND LANDING DATA

			INSTALL OR REINSTALL			CURRENT OR REMOVE		NET		
S/N	DATE	AIRLINE	HOURS	LANDINGS	DATE	HOURS	LANDINGS	HOURS	LANDINGS	REMARKS
0		0	0	0		0	0	0	0	0
1	03-19-80	1	0	0	--------	21069	11744	21069	11744	2
2	03-19-80	1	0	0	--------	21069	11744	21069	11744	2
3	03-27-80	1	0	0	03-07-82	6201	3013	6201	3013	1
4	03-27-80	1	0	0	03-07-82	6201	3013	6201	3013	0
4	08-20-82	1	6678	3353	--------	20659	11694	13981	8341	2
5	04-25-80	1	0	0	--------	20659	11694	20659	11694	2
6	04-25-80	1	0	0	08-20-82	6678	3353	6678	3353	1
7	04-30-80	1	0	0	--------	20924	11697	20924	11697	2
8	04-30-80	1	0	0	--------	20924	11697	20924	11697	2
9	06-01-80	1	0	0	--------	20132	11338	20132	11338	2
10	06-01-80	1	0	0	--------	20132	11338	20132	11338	2

REMARKS CODE UNITED=1
0=OLD DATA, 1=IN STORES, 2=CURRENTLY ACTIVE, 3= OUT FOR REPAIR OR EVALUATION

TOTAL NET HOURS= 177970 TOTAL NET LANDINGS= 98972

ELEVATOR FLIGHT HOURS AND LANDINGS

S/N	HOURS	LANDINGS	AIRCRAFT
1	21069	11744	N7459U
2	21069	11744	N7459U
3	6201	3013	STORES
4	20182	11354	N7461U
5	20659	11694	N7461U
6	6678	3353	STORES
7	20924	11697	N7462U
8	20924	11697	N7462U
9	20132	11338	N7466U
10	20132	11338	N7466U

APPENDIX C

NASA/BOEING 737 GRAPHITE COMPOSITE STABILIZER SERVICE HISTORY

Five shipsets of 737 graphite composite stabilizers were fabricated for Contract NAS1-15025 with the prime objective of demonstrating the feasibility of fabricating, certifying, and the entrance into service of composite primary structure.

Five shipsets (10 units) entered service with Delta Airlines and Mark Air in 1984. A summary of accumulated hours and landings is shown in Table C1.

No service difficulties have been seen. A scheduled detailed inspection was conducted on N670MA after 7000 hours of service. No anomalies were found.

CURRENT STABILIZER FLIGHT-HOURS AND LANDING DATA

S/N	DATE	INSTALL OR REINSTALL AIRLINE	HOURS	LANDINGS	CURRENT OR REMOVE DATE	HOURS	LANDINGS	NET HOURS	LANDINGS	REMARKS
0		0	0	0		0	0	0	0	0
1	03-13-84	1	0	0	--------	7458	7759	7458	7759	2
2	03-13-84	1	0	0	--------	7458	7759	7458	7759	2
3	03-16-84	1	0	0	--------	7131	7386	7131	7386	2
4	03-16-84	1	0	0	--------	7131	7386	7131	7386	2
5	05-11-84	2	0	0	--------	7542	8593	7542	8593	2
6	05-11-84	2	0	0	--------	7542	8593	7542	8593	2
7	06-22-84	3	0	0	--------	6473	7340	6473	7340	2
8	06-22-84	3	0	0	--------	6473	7340	6473	7340	2
9	08-18-84	2	0	0	--------	5954	5728	5954	5728	2
10	08-18-84	2	0	0	--------	5954	5728	5954	5728	2

REMARKS CODE DELTA=1, MARKAIR=2, AMERICAN WEST=3
0=OLD DATA, 1=NO LONGER ACTIVE, 2=CURRENTLY ACTIVE, 3= OUT FOR REPAIR OR EVALUATION

TOTAL NET HOURS= 69116 TOTAL NET LANDINGS= 73612

STABILIZER FLIGHT HOURS AND LANDINGS

S/N	HOURS	LANDINGS	AIRCRAFT
1	7458	7759	N314DL
2	7458	7759	N314DL
3	7131	7386	N307DL
4	7131	7386	N307DL
5	7542	8593	N670MA
6	7542	8593	N670MA
7	6473	7340	N170AW
8	6473	7340	N170AW
9	5954	5728	N672MA
10	5954	5728	N672MA

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